ITOMOLOGY LIBRARY
19 JUN 1954
ERIAL U.S.A.-109
EPARA

The Florida Entomologist

JUNE, 1954

Vol. XXXVII No. 2

Commemorative Issue
Centennial of Professional Entomology

CONTENTS

Page

TISSOT, A. N., MILLEDGE MURPHEY, JR. and R. E. WAITES—A brief history of entomology in Florida 51

TISSOT, A. N., and FRANK A. ROBINSON—Some unusual insect nests 73

SPENCER, HERBERT, MAX R. OSBURN and PAUL A. NORMAN—Effect of ground and spray applications of zinc compounds on infestations of purple scales 93

MAYEUX, HERMAN S.—Malathion for house fly control 97

MULRENNAN, J. A.—Expanded mosquito control and research in Florida 105

Published quarterly by the FLORIDA ENTOMOLOGICAL SOCIETY

Box 2425, University Station, University of Florida, Gainesville

The
FLORIDA ENTOMOLOGIST

VOL. XXXVII JUNE, 1954 NO. 2

THE FLORIDA ENTOMOLOGICAL SOCIETY

OFFICERS FOR 1953-1954

President ..... D. O. WOLFENBARGER
Vice President ..... F. G. BUTCHER
Secretary ..... MILLEDGE MURPHEY, JR.
Treasurer ..... W. P. HUNTER
Executive Committee ..... I. H. GILBERT, J. W. WILSON

EDITORIAL BOARD

LEWIS BERNER ..... *Editor*
L. C. KUITERT ..... *Associate Editor*
W. P. HUNTER ..... *Business Manager*

Issued quarterly—March, June, September, and December. Subscription price to non-members $3.00 per year in advance; 75 cents per copy. Entered as second class matter at the post-office at Gainesville, Florida.

Manuscripts and other editorial matter should be sent to the Editor, Dr. Lewis Berner, Biology Department, University of Florida, Gainesville. Subscriptions and orders for back numbers are handled by the Business Manager, Mr. W. P. Hunter, Box 2425, University Station, University of Florida, Gainesville. The Secretary can be reached at the same address.

One zinc etching, not to exceed one-half page in size, or the equivalent thereof, will be allowed free. The actual cost of all additional illustrations must be borne by contributors. In general, the cost of a full page zinc etching is $7.50. Reprints of articles may be secured by authors if they are ordered before, or at the time proofs are received for correction; 25 copies furnished free to authors.

REPRINTS WITHOUT COVERS

Pages	1	2	3–4	5–8	9–12	13–16	17–20	21–24	25–28	29–32
50 copies	1.60	2.00	2.70	4.25	6.70	7.25	9.40	10.40	12.05	12.80
100 copies	1.95	2.40	3.20	5.10	7.80	8.60	11.00	12.95	15.10	16.20
Add 100 copies	.75	.75	1.10	1.60	2.70	3.10	3.70	4.80	5.85	6.20

Additional for Covers, with Titles and Author's Name

25 copies ..... $3.50 100 copies $5.00

A BRIEF HISTORY OF ENTOMOLOGY IN FLORIDA

A. N. TISSOT, MILLEDGE MURPHEY, JR. and R. E. WAITES [1]

The year 1954 marks the centennial of professional entomology in the United States. During the year an attempt will be made to give the people of our country information about our insect problems and to tell them about the contributions entomologists have made to the national economy and to the health and welfare of the people during the first "100 years of Professional Entomology." An effort will be made to reach every individual with some phase of the centennial celebration. Newspapers and magazines, radio and TV shows, and educational movies will bring various events to the general public. Entomology will be stressed in educational programs for children. Federal, state, and industrial laboratories will hold "open house" during 1954.

The centennial celebration gives us an opportunity to look back over the years and evaluate the great contributions made by entomologists in various parts of our country. It seems fitting and proper therefore, that we pause and review briefly the history of entomology in Florida. To tell the whole story of entomology in our state would require several volumes of the *Florida Entomologist*, so in the few pages allotted us we will mention only a few of the many entomologists who have worked here, and we will briefly relate some of the more significant events and achievements of past years.

EARLY HISTORY

One of the earliest records of entomological work in Florida is that of Mark Catesby, who was born in England about 1679. He came to America in 1712, landing in Virginia where he remained for seven years. Upon returning to England, his collections excited naturalist friends at whose suggestion he returned to America in 1722 to undertake a more serious study of the fauna and flora of the Carolinas and the neighboring areas. He returned to England in 1726 and these studies were finally published in 1731-1743 under the title, *A Natural History of Carolina, Florida and the Bahama Islands containing figures of the Birds, Beasts, Fishes, Insects and Plants.* The

[1] Florida Committee on Information for the Centennial of Professional Entomology, A. N. Tissot, Chairman.

plates were etched on copper by himself and colored under his supervision. Catesby was probably the first illustrator of North American insects.

In 1791, there was first published in Philadelphia what has now become a rather famous travel book. This was by William Bartram, the great uncle and encourager of Thomas Say. It was entitled *Travels Through North and South Carolina, Georgia, East and West Florida.* William Bartram was not primarily an entomologist but his name is mentioned here in the early entomology of Florida because intermingled with the sometimes eloquent passages on botany and ethnology are references to various insects. He began his explorations in Florida, Carolina and Georgia in 1772.

He mentions the presence of honey bees in East Florida and their absence in West Florida. On the banks of the "Musquitoe River" he found two or three species of beautiful butterflies and gives enough of a description to enable a Lepidopterist to recognize them. The cochineal insect on cactus also was noted by him and he devotes three pages to the "Ephemera."

Thomas Say, generally known as the "Father of American Entomology" and the first great systematic entomologist in this country, played a part in early Florida entomology. In the autumn of 1817, an expedition was organized and that winter Say, William Maclure, George Ord and Titian R. Peale visited the Sea Islands and adjoining coast of Georgia and penetrated into eastern Florida for the purpose of studying the fauna and collecting specimens. This trip, although productive, was cut short by the bad feeling which existed between the neighboring inhabitants of the United States and the tribes of Florida which was still under the control of Spain.

William Harris Ashmead (1855-1908) was one of the foremost authorities of the parasitic Hymenoptera in America and the world. He came to Florida to establish a printing house for agricultural literature. Here he founded the *Florida Dispatch,* an agricultural weekly in which he edited the scientific portion devoting most of his time to injurious insects. In 1887 he was appointed special field entomologist in the Division of Entomology, U. S. Department of Agriculture, Florida. The next year he became entomologist to the State Agricultural College and Experiment Station at Lake City, Florida. He also received the M.S. degree from the Florida State Agricultural College.

Ashmead was primarily a systematist but published extensively in many fields of entomology.

Other entomologists who played a part in the early history of Florida's entomology included Henry Clinton Fall, a leading worker on Coleoptera, who collected extensively in Florida. Herbert Knowles Morrison, one of the greatest American entomological explorers and collectors, collected insects in Florida in 1883 and near Key West in 1884-1885. Herbert Osborn, one of the greatest teachers of entomology and a systematist, author and editor of the first rank, had a short connection with the Florida Agricultural Experiment Station in 1921. Willis Stanley Blatchley, author of *Coleoptera of Indiana* and other publications had a winter home in Dunedin, Florida where he secured many fine records for beetles. He explored the locality of Paraside Key at Royal Palm Park in southern Florida. One of his books about Florida is entiled *A Nature Wooing* in which he describes the fauna and flora at Ormond by the sea and around the Upper St. Johns River.

On the feminine side of the profession there was Mrs. Annie Trumbull Slosson (1838-1926) who was a very successful collector of insects and a gifted writer on field studies. She collected at a winter home in Florida and a summer home in the White Mountains. Her ability to discover strange insects seems to have been unusual, but possibly may be accounted for in part by the fact that she had leisure to devote time to the exploring of unusual habitats, along with a keen perception of the uncommon members of the population. She was very generous in turning over her captures to specialists and there are many species named in her honor. For the most part she contented herself with descriptions of the habits or peculiarities of the insects she studied.

ENTOMOLOGY IN THE AGRICULTURAL EXPERIMENT STATIONS

The Florida Agricultural Experiment Station has played a prominent role in the insect control program of the state for two-thirds of a century. In 1888 the Station was organized at Lake City by the Board of Trustees of the State Agricultural College and in June of the same year Bulletin 2 was published. In it William H. Ashmead, who was on the Station staff for a short time, discussed the plum curculio, the peach tree borer, the corn aphid, and root-knot. Dr. Ashmead is best known for his work with hymenopterous parasites and in this

bulletin described two new species of aphid parasites. Jas. C. Neal, M.D., served as entomologist from 1889 to 1891 and in his first report recommended jarring the trees and the use of london purple to control the plum curculio. In the third annual report J. J. Earle, the assistant chemist, published some notes on the use of paris green, kerosene emulsion, and decoctions of tobacco and pyrethrum. He advocated the use of lime to prevent arsenicals from burning plants.

Professor P. H. Rolfs was named Entomologist and Botanist in 1891 and remained with the station until 1899. During those years he published bulletins on the horn fly of cattle, tomato fruitworm, San Jose scale, and insecticides. He discovered the San Jose scale at De Funiak Springs, Florida in 1893. Professor Rolfs returned to the station in 1906 as its director and served in that capacity until 1921. Mr. A. L. Quaintance was appointed Assistant in Biology in 1894 and worked with Rolfs for four years. He published on various insects including pests of vegetables, corn, tobacco, strawberries, and stored grains. Mr. F. S. Chamberlin has given us some interesting information on the early tobacco insect investigations in Florida. He mentioned that Professor Quaintance advocated spraying tobacco plants with paris green as a control for hornworms but he evidenced some concern regarding possible hazards to the consumer. Mr. Chamberlin also said that Dr. L. O. Howard described the tobacco insect paper by Quaintance as "the most comprehensive article yet published in this country." The illustrations for his papers were of such excellence that they occasionally are used in entomological publications even today.

H. A. Gossard was the station entomologist from 1899 to 1904. He was one of the early workers on citrus pests and published articles on scale insects, whiteflies, and other pests. He devised tents for fumigating large citrus trees and reported that bordeaux mixture on citrus caused a great increase of scale insects. The cottony-cushion scale became established at Clearwater in 1898 and Professor Gossard was instrumental in introducing the Australian ladybeetle to combat it. He told how the first shipment of beetles sent from California early in 1899 arrived in Lake City on February 13th, the day of the famous "big freeze," and were all dead on arrival. After two more discouraging failures the beetles were finally established and the venture was so successful that by 1901 the scale was practically wiped out.

Dr. E. H. Sellards followed Gossard as entomologist and in 1905 reported the first occurrence of the Colorado potato beetle in Florida. It was found in Escambia County, the westernmost county of the state.

In May, 1906, E. W. Berger accepted a position as assistant entomologist. The following year he became the station entomologist and remained with the station until 1911. Dr. Berger in his first report mentioned two kinds of snails which were found on citrus trees infested with whiteflies. One, found near Palmetto, he called the "Manatee Snail" and the other from Miami, the "Miami Snail." He found that the "Miami Snail" cleared sooty mold off citrus leaves at the average rate of five leaves per day while the "Manatee Snail" under similar conditions cleaned only one and a half leaves per day. In the same report Dr. Berger discussed the red aschersonia and other fungi on citrus whiteflies. All of his station reports contained information on these fungi and he continued to work with them with unflagging enthusiasm during the many years he was with the Florida State Plant Board.

An important event in the history of the Experiment Station took place in 1906 when it moved from Lake City to its present location in Gainesville, where the University of Florida had been established. In its new quarters the Station offices and laboratories occupied the south end of Thomas Hall.

Professor J. R. Watson became the station entomologist in 1911 and held this position until his death in 1946. One of his first assignments was an investigation of the velvet bean caterpillar. He also began working on root-knot soon after his arrival in Florida. He worked extensively on citrus insects and with Dr. Berger published a bulletin which for many years was the standard pest control manual of Florida citrus growers. Another of his bulletins on vegetable insects served a similar function for truck farmers. In the field of systematic entomology, Professor Watson is best known for his work on Thysanoptera. He described some 30 new species of thrips and assembled an extensive collection of these insects. In his later years he became interested in Lepidoptera, especially the skippers, and collected and studied them with zest. He was a charter member of the Florida Entomological Society and on more than one occasion came to its rescue when its fortunes were at a low ebb.

During the 35 years when he was entomologist, Professor Watson had many assistants who worked with him for vary-

ing periods. Among these were U. C. Loftin, A. C. Mason, H. L. Dozier, Evelyn Osborn, A. H. Beyer, H. E. Bratley, A. N. Tissot, E. F. Grossman, L. W. Ziegler, P. W. Calhoun and J. W. Kea. The present staff of the Entomology Department includes A. N. Tissot, Head, L. C. Kuitert, H. E. Bratley, F. A. Robinson, R. E. Waites, and S. H. Kerr, in addition to A. M. Phillips who is stationed at the Pecan Laboratory, and J. R. Christie, Nematologist. During the past decade the Department has done extensive work on insecticides in the control of pests of tobacco, vegetables, field crops, ornamentals, pecans, and livestock.

The Florida Legislature in 1917 took an action which has had a great influence on entomological work in Florida. It provided for a Citrus Branch Station at Lake Alfred, which became the first of numerous branch stations and field laboratories. Entomological work was started at the Citrus Station in 1924 when W. L. Thompson began investigations of the new citrus aphid, *Aphis spiraecola* Patch. Mr. Thompson has been at that station continuously and is considered a leading authority on citrus pest control. W. A. Simanton, M. H. Muma, R. B. Johnson, and R. M. Pratt are other entomologists at present on the Citrus Station staff.

Entomologists are now stationed at five other branch stations and at two field laboratories. W. C. Rhoades and F. E. Guthrie at the North Florida Station in Quincy are working on tobacco insects and pests of general farm crops. At the Everglades Experiment Station in Belle Glade, entomologists N. C. Hayslip, W. H. Thames, and W. G. Genung investigate pests of vegetables, sugarcane, fiber crops, and pastures. E. G. Kelsheimer, entomologist at the Gulf Coast Station in Bradenton, gives attention to vegetable insects in addition to pests of gladiolus, lawns, and pastures. In the far south at Homestead, is the Sub-Tropical Station where entomologist D. O. Wolfenbarger studies pests of tropical fruits and winter vegetables. At the Central Florida Station in Sanford, entomologist J. W. Wilson is working on insect pests of sweet corn, celery, cruciferous crops, and long staple cotton. T. M. Dobrovsky, entomologist at the Potato Investigations Laboratory in Hastings, is concerned principally with pests of Irish potatoes and crucifers. The Pecan Laboratory where Mr. Phillips is stationed is in cooperation with the Entomological Research Branch, U. S. D. A.

A discussion of entomology in the Experiment Station would be incomplete without mention of Wilmon Newell who was its Director from 1921 to 1943. Dr. Newell was an entomologist by training and with his natural ability was admirably fitted to direct the eradication campaign against the Mediterranean fruit fly and the investigation of such pests as the white-fringed beetle, the citrus blackfly, and the sweet potato weevil. In addition to being Director of the Experiment Station, Dr. Newell was Dean of the College of Agriculture, Director of Extension, and Plant Commissioner of the State Plant Board.

THE TEACHING OF ENTOMOLOGY IN FLORIDA

The Florida Agricultural College was established in Lake City in 1884 and four years later the Agricultural Experiment Station was organized by the Board of Trustees of the College. For several years the two institutions had a joint staff and the members did both teaching and research. Dr. J. C. Neal offered the first instruction in entomology in 1889. Other early teachers included P. H. Rolfs, A. L. Quaintance, H. A. Gossard, and E. H. Sellards. Dr. Sellards taught a course that stressed the economic phase of entomology, particularly on the insects of Florida and their control. By 1897, thirty-two students had graduated from the College. No doubt many of them had received training in entomology. The record shows that A. L. Quaintance received the B.S. degree from the college in 1893.

In 1906 the Station staff was separated from the regular faculty of the "University," though they continued to help with the teaching and gave " . . . series of lectures from time to time on the subjects and results of their special investigations." That same year the Agricultural College and the Experiment Station were moved from Lake City to Gainesville and became part of the newly organized University of Florida. The records are rather obscure but it is presumed that Dr. E. W. Berger, who became the station Entomologist in 1906, gave some instruction in entomology. In 1908 Dr. H. S. Davis was appointed Professor of Zoology in the College of Arts and Sciences. He offered a course in entomology and another in economic zoology for students in agriculture. In 1923, Dr. T. H. Hubbell began teaching a course in entomology in the Biology Department of the College of Arts and Sciences and in the same year Prof. John Gray offered a course in agricultural entomology in the College of Agriculture.

In 1924 the Department of Economic Entomology and Plant Pathology was established in the College of Agriculture. Professor Gray became Head of the Department and served until 1929. Professor Ralph D. Dickey joined the staff as an instructor in plant pathology in 1928. He was made interim Acting Head of the Department the following year and served in that capacity until 1933. Dr. John T. Creighton, to whom we are indebted for much of the information in this section, became a member of the Department in 1928, and in 1933 was elevated to his present position, Head of the Department. In 1939 the work in plant pathology was transferred to the Botany Department, and the Department of Economic Entomology and Plant Pathology became the Department of Entomology. Dr. Homer Hixon was a member of the department from 1937 to 1946. The present staff, in addition to Dr. Creighton, includes L. A. Hetrick, Milledge Murphey, Jr. and Andrew J. Rogers. Some entomologists on the Experiment Station staff serve in a cooperative capacity and assist students with their theses and special assignments.

The Department of Entomology has grown rapidly under the leadership of Dr. Creighton. It has achieved an enviable teaching record and is well known, not only in Florida, but throughout the nation. More than 200 men and women have received the Bachelor of Science degree in entomology and 60 or more have received advanced degrees from this department. Entomology graduates from the University of Florida are found throughout the world working successfully in many fields of professional entomology. The Department now offers courses in many phases of the science including agricultural entomology, plant quarantine, public health, structural pest control, apiculture, forest entomology, and insecticides, as well as the more academic aspects of entomology as morphology, taxonomy, physiology, and ecology. Twenty-three undergraduate courses and eleven at the graduate level are now offered by the Department. The entomology faculty has a close association with the Newell Entomological Society and students thus receive special training not ordinarily given in entomology courses.

In 1934, Dr. Creighton and his staff planned and organized a special Pest Control Division which is responsible for all pest control on the University campus. This Division now has a full time Assistant Supervisor and several pest control operators, all of whom are students in the Department of Entomology.

Students assigned to this work receive practical experience in the field of structural pest control as well as commercial spraying. Dr. Creighton also was prominent in the advancement of structural pest control. He prepared the Structural Pest Control Law which was presented to the Florida legislature and passed in 1947. This law has had a tremendous influence in raising the standards of commercial pest control in Florida.

Although the University of Florida is the only institution in the state that grants degrees in entomology, other universities, colleges and junior colleges give courses in biology or zoology that include work on insects.

STATE PLANT BOARD OF FLORIDA

The State Plant Board, the plant regulatory agency of Florida, was created by an act of the Legislature on April 30, 1915. The threat of the citrus canker disease to the Florida citrus industry was the impelling force which brought about the passage of the Plant Act. The Act stipulated that the State Plant Board consist of five members, they to be the same persons who constituted the Board of Control. At the first meeting of the Board, Prof. P. H. Rolfs, Director of the Florida Experiment Station, Mr. L. S. Tenny, Secretary-Manager of the Florida Growers' and Shippers' League, and Mr. W. J. Krome, a Homestead fruit grower, were appointed as an Advisory Committee to carry out the duties of the Plant Commissioner until one could be named. These men were largely responsible for the passage of the Plant Act and several years later Prof. Rolfs stated that Mr. Krome wrote the act as well as the first rules and regulations of the Board. Dr. Wilmon Newell was the first Plant Commissioner and to him goes much of the credit for the excellent record of the Plant Board and the position of high esteem which it has so long enjoyed.

In the beginning the work of the Board was carried on by the Departments of Citrus Canker Eradication, Nursery Inspection, Plant Pathology, Port and Railway Inspection, and Entomology. Later, the Department of Apiary Inspection was added, and the Department of Citrus Canker Eradication was changed to the Department of Grove Inspection, and Port and Railway Inspection was changed to Quarantine Inspection.

Dr. E. W. Berger, who had been Inspector of Nursery Stock since 1911, under the Nursery Act, was elected Entomologist

of the new Plant Board and became the first head of the Entomology Department. His first assistant was A. C. Mason who was followed by C. F. Wilson, F. F. Bibby and G. B. Merrill. Upon the retirement of Dr. Berger in 1942, Mr. Merrill became Head of the Department. For several years the principal function of the department was to culture red aschersonia fungus and rear the Australian ladybeetle for distribution to citrus growers for the control of whiteflies and cottony-cushion scale in their groves. Some experimental work on the control of various other pests of farms and orchards also was done. Many articles in *The Bulletin*, the official publication of the Plant Board, contain life history studies and control recommendations made by this department.

Early workers in other departments included F. M. O'Byrne, Nursery Inspector; Frank Stirling, General Inspector in charge of Canker Eradication; and Dr. J. H. Montgomery, Quarantine Inspector. Mr. C. E. Bartholomew, the first Apiary Inspector, was followed by J. C. Goodwin and R. E. Foster.

From its beginning the State Plant Board has actively protected Florida's agriculture and horticulture from pests both from within and outside the state. The Board has the enviable record of eradicating three important plant pests from our state. These were: the bacterial disease, citrus canker; the Mediterranean fruit fly; and the citrus blackfly.

A history of entomology in the Plant Board would not be complete without further comments on the Mediterranean fruit fly and the citrus blackfly eradication campaigns. Shortly before the fruit fly was found in Florida Dr. Newell gave a talk in which he expressed the opinion that the failure to eradicate several pests, which had been introduced into this country, was due to "temporizing and delay." From the outset there was no "temporizing or delay" in the battle against the "Med" fly. The first fly maggots found in grapefruit at Orlando on April 6, 1929 were tentatively identified as a species of *Anastrepha*. Positive identification was made on April 11th when the larvae were found to be the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Plant Board inspectors were rushed to Orlando on April 8th and by April 30th they had found fruit fly infestations on 364 properties in 51 localities in 11 different counties. The seriousness of the situation was apparent and $50,000 of state emergency founds were made available April 15th. Two days later $40,000 of Federal funds were allocated. The National

Congress rose to the occasion and on May 2nd appropriated $4,250,000 for the campaign. On June 7th the Florida Legislature appropriated $500,000 to aid in the fight.

Dr. Newell marshalled all available forces of men and equipment and planned how to use them to best advantage. Training schools were set up, quarantines promulgated, surveys broadened and intensified, and eradication measures started immediately. At the height of the campaign 6,300 men were engaged in the fight. It was necessary to destroy 189,108 boxes of citrus fruits, 49,974 bushels of vegetables and 27,395 bushels of non-citrus fruits. A tabulation of records showed that infestations had been found on 1,002 properties in 20 counties and the eradication area covered 15,000 square miles. It is significant that this included 73 percent of Florida's citrus acreage. The last specimen of the Mediterranean fruit fly found in Florida was a pupa collected in St. Augustine on July 25, 1930. Even today, it is almost unbelievable that a pest so well established over so wide an area could be eradicated in just a little over a year and at a cost of only $7,573,136.91.

A few years later the citrus blackfly was found to be well established in Key West. Although this pest was found in an isolated and rather restricted area, many difficulties were encountered. There was considerable opposition to this campaign and much legal action was involved. In fact, during the last few months of the spraying program it became necessary to assign a deputy sheriff to each spray truck. Even though this project required two and a half years for completion it still was a remarkable accomplishment.

During the past several years the Plant Board has carried on control programs against the sweet potato weevil and the imported fire ant, and has made surveys and investigations of such pests as the cotton boll weevil, the green citrus aphid, West Indian fruit flies, the Japanese beetle, and others.

Although port inspection work is not entirely entomology it none-the-less has much to do with insects. This arm of the Plant Board each year keeps out of Florida many pests which do not presently occur here. During the biennium 1950-52 the port inspectors examined 16,873,807 parcels of plants and plant products. Many of these contained pests of various kinds and 20,719 were destroyed and 45,198 others were refused entry. Over six million parcels were fumigated or otherwise processed and then allowed to enter the state. These inspections revealed

such unwelcome stowaways as South American and West Indian fruit flies, the Mediterranean fruit fly, pink bollworm, many species of beetles and moths and many others of economic importance.

The State Plant Board has the largest and most complete entomological library in the South. It has accumulated an extensive insect collection which is generally regarded as the finest in the southeast for both economic and non-economic species. The Plant Board also maintains a card catalog which now contains over 117,000 collection records of insects. These are cross indexed in three ways—to insect, host, and collection number.

During the 39 years of its existence the State Plant Board has had three Plant Commissioners. Dr. Newell served from 1915 until his death in 1943. He was succeeded by Mr. A. C. Brown who retired in 1952 and was followed by the present Commissioner Mr. E. L. Ayers.

THE STATE BOARD OF HEALTH

The dread of yellow fever in the State of Florida gave birth to the present State Board of Health. The epidemic of yellow fever in Fernandina and Jacksonville in 1877 was described by early writers as the "greatest holocaust to ever strike the State." The census of Fernandina, taken on September 20th of that year, showed a population of 1,632, with 1,146 cases of fever reported. Early writers on Florida had much to say about the biting insects and the pestilence malaria. The Count of Castlenau in 1842 revealed what malaria meant to the Tallahassee of a hundred years ago. "But unfortunately in opposition to these numerous advantages there are the greatest plagues that can afflict a new settlement; and unhealthful climate; every year bilious fevers of a most dangerous nature spread consternation to the whole region . . . However, although the climate is dangerous for strangers at all times, the most insalubrious months are August, September, October and November; then no one can be sure of escaping the plague, neither the planter who has been settled in the country for years, nor the negro born in the midst of the miasma of Carolina or under the burning sun of Georgia. The comparative extent of the huge cemeteries is a sad warning for one who, charmed by the beauty of the sight, would want to establish himself in this region."

The first direct reference to the control of malaria in Florida was made as early as 1900 by Dr. J. Y. Porter, Florida's first State Health Officer, when he stated, "It was observed that the attacks (of malaria) were more than usually fatal along the river bottoms, marsh lands, and in the flat woods country. It now is seen that it is not the germ itself which rises from the soil or water, but the carrier of the germ."

It was not until 1919 that the State Board of Health undertook its first malaria control project in the city of Perry, a typical malarious community in Florida. At that time it was one of the largest projects of the kind in the country and involved the removal of 47,000 cubic yards of earth for drainage canals and ditches at an expenditure of $28,000. The cost of this first project was borne by the City of Perry, the County of Taylor and the Burton Swartz Cypress Company, with the State Board of Health supplying the technical supervision.

A great step forward in the control of mosquitoes was the organization of the Florida Anti-Mosquito Association in 1922. This organization has been primarily responsible for promoting legislation for the creation of mosquito control districts and making possible "State Aid" in districts and counties.

In 1931 the Rockefeller Foundation established a malaria research station at Tallahassee to work with the State Hospital at Chattahoochee and the State Board of Health. This station under the direction of Dr. Mark F. Boyd from 1931 until its closing in 1947, performed work in the malaria field of inestimable value, not only to the State of Florida, but also to the world as a whole.

The year 1933 marked the beginning of widespread malaria and pest mosquito control operations throughout the State. The work was performed by the WPA and other federal relief organizations until 1941 when relief funds were withdrawn. A tremendous amount of drainage work was accomplished. The records show that over 1,582 miles of ditches were dug with the removal of 225,287 cubic yards of earth.

In 1941 a Bureau of Malaria Control was created with the Florida State Board of Health for the purpose of studying and making recommendations for controlling malaria in the State. In 1945 the widespread program of DDT residual house spraying to eradicate malaria was inaugurated in those counties which had a high malaria rate in the past. It is interesting to know that the last known case of malaria transmission in

Florida was reported in 1948 and the last case of yellow fever was reported in 1905.

In 1946 the Bureau of Malaria Control was abolished and a Division of Entomology was established within the Bureau of Sanitary Engineering, with John A. Mulrennan as Director. In 1953 the Division of Entomology was raised to independent Bureau status. Mr. Mulrennan has given us much of the information in this section and we are grateful to him for this favor.

Mosquito control legislation has played an important part in the growth of entomology in the State Board of Health. The first law making it possible for a county to vote for a mosquito control district was passed in 1925. The state law providing for "State Aid" to counties and mosquito control districts was passed in 1949. In 1953 a second "State Aid" bill was passed whereby any Board of County Commissioners or Mosquito Control District that places funds in its budget for the control of "arthropods of public health importance," would receive funds directly from the State in the amount of 75 percent of the total amount appropriated by the county or district. These funds are to be used exclusively for permanent eliminative measures.

At the present time there are 23 mosquito control districts in 21 of Florida's 67 counties and the total monies spent in the state for controlling arthropods of public health importance annually exceeds $3,322,000 under the supervision of the State Board of Health.

FEDERAL ENTOMOLOGICAL WORK IN FLORIDA

We could not determine exactly when the Federal Government started its entomological work in Florida but it seems probable that Townend Glover, the first federal entomologist, also was the first to work in our state. It is known that he spent some time in the South investigating cotton insects and that he visited Florida then. His reception must not have been very pleasant for on his return to Washington he penned the following lines:

> "From red-bugs and bed-bugs, from sand flies and land flies,
> Mosquitoes, gallinippers, and fleas,
> From hog-ticks and dog-ticks, from hen lice and men lice,
> We pray Thee, Good Lord, give us ease."

H. G. Hubbard, as a special agent, was stationed at New Smyrna, Florida, from 1881 to 1884. He gave particular attention to citrus insects and was called upon for advice when the cottony-cushion scale was found at Clearwater in 1898. His bulletin, *Insects Affecting the Orange,* published in 1885 was considered an entomological masterpiece and still is regarded highly today.

For nearly half a century the Bureau of Entomology has maintained laboratories in Florida. Often these were set up to investigate specific insects or the pests of some particular crop. Some remained active for many years while others operated for only a short time. We will mention only a few of the many laboratories located in Florida.

The Division of Fruit Insect Investigations has operated laboratories for the study of citrus pests for many years. A laboratory was established at Orlando in 1907 with A. W. Morrill in charge. Mr. W. W. Yothers came to the laboratory the following year and remained there until his retirement in 1935. White flies received the principal attention of the entomologists for several years but work was also done on scales, rust mites and other pests. Dr. Herbert Spencer went to the laboratory in 1935 and was in charge until 1946 when he was transferred to Fort Pierce to study citrus insect problems peculiar to the Indian River area of Florida.

A field laboratory to investigate celery insects was established at Sanford in 1925. It was operated cooperatively by the Florida State Plant Board and the Division of Truck Crop and Garden Insects. Dr. E. D. Ball, in charge, and J. A. Reeves represented the Plant Board while B. L. Boyden and W. E. Stone were federal workers. At Quincy, F. S. Chamberlin of the Tobacco Insects Laboratory has given attention to pests of shade grown tobacco.

The Division of Insects Affecting Man and Animals set up a laboratory in Gainesville in 1935, with W. G. Bruce in charge, to investigate the screw-worm which had become established two years earlier and had already spread to all but one county of the state.

We are indebted to Dr. W. V. King, who for many years was in charge, for information on the laboratory and field station established in Orlando in 1931 for the investigation of mosquitoes of the Southeastern States. The *Mansonia* mosquito problem in central Florida, salt-marsh mosquitoes of the ex-

tensive coastal areas, and malaria mosquitoes in central and northern Florida received special attention. Some work was done on the "dog fly" (*Stomoxys*) problem of the northwest Florida coast, screw-worms in livestock, and the fever tick problem in native deer.

Shortly after the beginning of World War II, with funds from the National Research Council, the laboratory was greatly expanded for the study and development of methods for the control of insects of medical importance to the armed services. Much of the early work with DDT was done there. Effective methods for the control of human lice, mosquitoes, and chiggers, developed at the laboratory, were quickly adopted by the military. This resulted in a great reduction of disease rates in the allied troops. For these investigations the laboratory was given the Distinguished Service Award of the Department of Agriculture.

Following the war, funds were provided by the military services for the continuation at the Orlando laboratory of investigations of military insect problems. Reared colonies of several important insects were maintained and these were used in an extensive screening program in which thousands of promising insecticides and repellents were tested.

Experiments at the Orlando laboratory were the first to show the possibility of the development of increased resistance to DDT in house flies exposed to DDT sprays in successive generations. Similar increased resistance to DDT in body lice in Korea, first noted by Army and Navy entomologists, was confirmed at the Orlando laboratory and substitute insecticides were then developed and field tested among troops in Korea.

THE ROLE OF INDUSTRY IN FLORIDA ENTOMOLOGY

Without doubt Florida farmers of a hundred years ago were troubled with insect pests. Perhaps most of them accepted these as an inevitable nuisance and did nothing about it but a few almost certainly used such remedial measures as hand picking or dusting their plants with road dust or lime. Some years later they began to use paris green and a few other insecticides. Except for paris green and london purple, practically all insecticides used before 1900 were made at home. Lead arsenate and crude oil emulsions were used experimentally as insecticides during the last decade of the 19th century. In 1906 the commercial production of lime-sulfur began and the follow-

ing year Grasselli Chemical Company began the commercial manufacture of lead arsenate insecticides. About 1908 Wilmon Newell, who was then working in Louisiana, demonstrated that the boll weevil could be controlled with powdered arsenate of lead. His work undoubtedly was a great stimulus to the use of insecticides in the South and this naturally promoted the manufacture of insecticides in this area.

For the next quarter century the use of insecticides gradually expanded and then about 1936-38 there was a tremendous growth in the manufacture, sale, and use of insecticides. This was due to various causes including recovery from the depression, improvement of insecticides through research, and the education of the public in the value and use of insecticides.

The next great expansion came with explosive suddenness in 1945-46 with the advent of DDT and related chlorinated hydrocarbon insecticides. These new materials made it possible to control insects better than ever before but each insecticide was found to be ineffective against some pests. This led to increased research by chemical and insecticide companies and in experiment stations and universities. While the wave of interest in these insecticides still ran high, a new group of materials, the phosphatics, appeared. These were different from the other materials in mode of action and they also presented new hazards to manufacturers and users. The insecticide industry is to be commended for the way it joined other research workers in studying the problem and developing protective measures which now make it possible to use these insecticides safely.

We could not learn when or where insecticides first were manufactured in Florida but it seems fairly certain that oil emulsions and lime-sulfur were the first ones made. The manufacture of these continued to grow in volume and it was estimated that in 1950, six million gallons of oil emulsion, 20,000 gallons of lime-sulfur concentrate and 100 million pounds of dusting sulfur were produced in Florida. Few, if any, of the basic materials used in making insecticides are produced in Florida but enormous quantities of insecticides are formulated and processed here as the above figures show. There now are approximately 50 formulators operating in the state and at least 17 of these concerns have one or more entomologists on their staffs. These men do research work, they carry on field experiments with agricultural workers and farmers, and they

serve as "trouble shooters" who investigate reports of poor control, plant injuries, or other troubles associated with the use of insecticides. A dozen or more national pesticide companies now maintain representatives in Florida and many of these men have had entomological training. Some of the insecticide companies further promote entomological research in our state by providing at the University of Florida and elsewhere, scholarships and fellowships which enable students to work on various entomological problems of importance to Florida agriculture.

No small part of the research work done by insecticide companies has been concerned with the development and testing of new materials to replace older ones which have lost some of their effectiveness or otherwise are deficient. To cite just one example we call attention to DDT. At first, this insecticide appeared to be effective against practically all insects. Within a very short time house flies, some mosquitoes, and certain other pests developed a resistance to DDT which made it unsatisfactory as a means of control. Lindane came into the picture and for a time it served well but now it is being replaced by malathion and diazinon. We can expect this process to continue for it is unlikely that an insecticide will be developed which will control a wide variety of pests and maintain its effectiveness permanently.

In Florida the most cordial relationship exists among the insecticide industry, the agricultural research agencies, and the farmers of the state. Without doubt the Florida Agricultural Research Institute has helped materially in bringing about this accord. F. A. R. I. is an association of concerns interested in the manufacture and sale of materials used in Florida agriculture. It fosters research in the Agricultural Experiment Stations and other state institutions and works closely with the State Department of Agriculture in formulating rules and regulations pertaining to the manufacture, licencing, and sale of pesticides, fertilizers and seeds. The *Handbook on Pesticides and Their Uses in Florida Agriculture*, prepared by committees representing the Experiment Stations, the Extension Service, and the Insecticide Industry was sponsored and financed by F. A. R. I.

In closing this section we are happy to report that Florida's rules and regulations governing pesticides, as administered by the State Department of Agriculture, are generally con-

sidered among the best in the land. This assures farmers and other users of insecticides that they will get dependable products. It also is of interest to know that Florida's insecticide industry now has enough plants, facilities, and trained personnel to formulate all kinds of insecticides in sufficient quantities to supply the normal needs of the state.

INTRODUCED PESTS

The great majority of our more troublesome insect pests are immigrants which came to our state from other places. Early explorers brought on their persons or on their livestock, lice, fleas, mange mites and stomach bots. Later settlers and colonists brought in with their household effects and food stores such pests as bed bugs, clothes moths, carpet beetles, cockroaches, larder beetles, rice weevils and meal moths. Many pests of foreign origin came to Florida from other states where they had become established earlier. This group includes onion thrips, imported cabbageworm, San Jose scale, fowl tick, sweet potato weevil, imported fire ant, vegetable weevil and cottony-cushion scale. H. A. Gossard, in Bulletin 56 of the Florida Experiment Station, published in May 1901, gives an interesting account of the early history of the cottony-cushion scale in Florida. Space will not permit us to tell the story here but it is one of the most outstanding examples of satisfactory biological control of a major crop pest.

Though many of our introduced pests came to Florida from other places in this country, some came direct from foreign lands. One of the first to arrive was purple scale which came from Bermuda in 1857, nearly a century ago. In 1879 Florida red scale came from the West Indies and in 1898 the sticktight flea arrived from Central America. The Mediterranean fruit fly, presumably from southern Europe, was found in Florida in 1929. In 1936 the white-fringed beetle was found to be well established in two north Florida counties and in neighboring counties of Alabama. One of the most recent invaders was the cattle tail louse from Africa which was found here in 1945. Each of these pests seemed to pose a major threat to some agricultural enterprise but through the intervention of entomologists and other scientists means were found for successfully combating them.

The eradication of the Mediterranean fruit fly from Florida surely is the most salient example of what can be accomplished

by coordinated effort under able leadership to be found anywhere in the archives of entomology. Dr. Wilmon Newell was largely responsible for developing the Florida State Plant Board and elevating it to a position of high esteem, not only in Florida, but throughout the nation. Under his leadership citrus canker had been eradicated from Florida, so it was logical to make him field director of the combined state-federal eradication effort in the fruit fly campaign. Dr. Newell met this emergency with immediate action and in less than two years the pest was eradicated. Dr. Herbert Osborn in his *Fragments of Entomological History* refers to the fruit fly campaign as follows: "No more spectacular achievement in Economic Entomology can I think be cited in the history of man's warfare with insects." Newell Hall and Newell Drive on the Universty of Florida campus and the Newell Entomological Society, a student organization at that institution, are lasting memorials to this renowned entomological leader.

ENTOMOLOGICAL SOCIETIES

Before closing this essay we needs must mention the entomological societies of our state. The Florida Entomological Society was organized at the University of Florida in Gainesville, January 5, 1916, by eleven men interested in entomology. Professor J. R. Watson was the first president and Dr. Wilmon Newell was vice-president. The membership more than quadrupled the first year and by the end of 1917 there were nearly a hundred active members. This is the oldest entomological society in the Southern States. Two of the original charter members, Mr. K. E. Bragdon and Mr. J. C. Goodwin are still active in the Society. The Society now has a membership of 275 including Honorary Members, Charles T. Brues, O. A. Johannsen, James G. Needham, Herbert Osborn, Edith M. Patch, and W. W. Yothers.

At the April 1917 meeting, Dr. E. W. Berger proposed that the Society published a periodical to be known as *The Florida Buggist*. His proposal was accepted and the first issue appeared June 21, 1917. In 1920 the Society voted to change the name to *The Florida Entomologist*. The periodical is published quarterly and now is in its thirty-seventh volume. Professor Watson was the editor from the beginning until June 1946. Dr. H. K. Wallace was editor from 1947 to 1950 and since then Dr. Lewis Berner has been editor.

The Newell Entomological Society was organized by the students and faculty of the Department of Entomology of the University of Florida in 1935 in honor of Dr. Wilmon Newell. This society was created for the purpose of advancing all phases of entomology, and in the promotion of good fellowship, cooperation and leadership among entomologists. Dr. Herbert Osborn was the speaker at the installation ceremony in February, 1936 during the first annual Florida Entomological Conference sponsored by the Society. A birthday banquet honoring Dr. Osborn was a feature of the second annual conference in March, 1937. Dr. H. T. Fernald was honored at the third conference in 1938. This custom was continued and some outstanding entomologist was honored at the banquet session of succeeding conferences. Mr. W. P. Hunter was the first president of the Society. During the present school year Mr. Darrell Anthony is president of the Society which now includes about thirty student members.

In 1938 both the Florida Entomological Society and the Newell Entomological Society petitioned the American Association of Economic Entomologists for affiliate membership in that organization. These requests were reported upon favorably by the Executive Committee and approved at the annual meeting of the American Association held in Richmond, Virginia in December, 1938. This was the first time in the history of the Association that a student society was granted affiliation privileges.

In conclusion, we wish to repeat that this sketch admittedly is deficient in some respects. We perhaps have placed too much emphasis on some parts and may have omitted things that should have been included. We regret that time would not permit us to submit the manuscript to the various organizations mentioned for review before the paper went to press. Please bring to our attention any serious errors or discrepancies noticed and we will consider correcting them in a later issue if in our opinion and that of the Editor the circumstances warrant doing so.

PRINTING

FOR ALL PURPOSES

Carefully Executed ● Delivered on Time

PEPPER PRINTING COMPANY

GAINESVILLE - - - - - - - - - - FLORIDA

Check these ORTHO Advantages:

1. Expert practical advice by experienced *ORTHO* Fieldmen.
2. Quick delivery and fresh material from local plants.
3. Finest research facilities assure latest information on new pest controls.
4. *ORTHO* Field News Letters give complete technical data on local pest problems. Write to be placed on mailing list.
5. *ORTHO* labels are guaranteed for ingredient contents.
6. Quality products from the control laboratories working 'round the clock to assure accuracy of ingredients.

ORTHO
SCIENTIFIC PEST CONTROL

CALIFORNIA SPRAY-CHEMICAL CORP.
P. O. Box 1231, Orlando, Florida

World leader in scientific pest control

SOME UNUSUAL INSECT NESTS [1]

A. N. TISSOT and FRANK A. ROBINSON
Entomology Department, Agr. Exp. Sta., University of Florida

On June 21, 1951 a perturbed resident of Gainesville, Florida, called the Entomology Department of the Agricultural Experiment Station and reported that she was greatly concerned about a large wasp nest near her home. The usual answer that wasp nests are commonly found around residences in Florida and that the insects rarely sting, unless they are disturbed, did not suffice in this case. Having learned from experience that home owners generally are rather helpless to cope with such situations, we decided to call on the lady to see what help could be given.

When we saw the nest our curiosity was immediately aroused and we expressed a desire to study it further; for instead of finding a large nest of *Polistes* as expected, this proved to be a colony of yellowjackets. We tried to persuade the lady to allow the nest to remain for further observations, but it was only a few feet from her front door and she very emphatically did not want it there. Consequently we began to plan how the insects might best be dispossessed.

Many interesting things were found during the removal and demolition of the nest. Specimens of the insects were collected and sent to Washington for identification. Mr. K. V. Krombein of the Division of Insect Identification determined them as *Vespula squamosa* (Dru.). Having been informed of the location of the nest, he wrote that the site was most unusual. He stated that, according to published records and from his personal observations, the species always makes its nest underground. We had previously known about another nest in a similar situation and we have since studied additional nests of the same species. Because of the unusual circumstances and locations of some of the nests and in view of the fact that the habits of the yellowjackets here are so different from those generally attributed to them, we believe that they may be of general interest. We herewith make known this additional information concerning them.

The first mentioned nest was built on the upper part of the trunk, just below the spreading crown of a large *Phoenix* palm.

[1] Florida Agricultural Experiment Station Journal Series, No. 247.

The bottom of the nest was approximately ten feet from the ground. At one time the trunk of the palm had been completely covered by a dense growth of ferns. Some unknown disorder killed the ferns, and their remains, together with the decaying stubs of the old palm fronds, formed a deep layer of porous but firm material which completely surrounded the upper trunk and extended downward several feet from the living crown. The nest lay snug and protected in this layer on the north side of the palm.

Fig. 1.—Yellowjacket nest on Phoenix palm showing details of structure of outer envelope.

It was quite obvious that the nest was a large one but when it was uncovered and fully exposed we learned that it was a great deal larger than we first thought. It was a broad bow-like structure which followed the curvature of the palm trunk. The outside arc of the nest measured six feet and it extended 30 inches from top to bottom. It averaged about 12 inches in depth from front to back. Figure 1 is a close-up photograph of the nest showing the details of the outer envelope.

Yellowjackets generally are reported to be belligerent creatures but these did not prove so. It is true that we donned bee

veils to remove some of the drooping palm fronds and other obstructions preparatory to taking pictures of the nest, but we worked bare handed. An occasional insect buzzed about us, but they were not very aggressive and there was no indication of concerted attack.

The outer envelope of the nest was not a continuous sheet but was formed by many overlapping sheets of paper with small spaces between. This formed a ventilated outer wall an inch or more thick. The insects seemed to be able to go in and out almost anywhere between the sheets of the wall but there were some eight or ten openings with reinforced edges which served as regular gateways. The location of the nest made it virtually impossible to enclose it for fumigation so we decided to attack the colony by other means. A ladder was placed against the palm so the nest could be reached easily and an aerosol bomb was discharged into all the nest openings. After a few moments numbers of yellowjackets began to emerge from the nest and drop to the ground. They were mostly workers but an occasional queen was noted.

The next step was to remove the enveloping plant material and thus expose the nest. Some mention had been made of preserving the nest for a museum specimen so care was taken to avoid damage to the outer envelope. This could not be prevented entirely since it extended in several places into pockets in the surrounding material. Although the aerosol had stopped insect activity at the front of the nest, it obviously did not affect the deeper portions. At the first attempt to remove the debris by hand some half dozen yellowjackets darted out and in a fraction of a second each inflicted a sting on a hand or wrist. From then on a hand weeder was used to remove the debris. As each piece was pulled away, the newly exposed part of the nest was immediately sprayed with a household spray. By the time the operation was completed the entire contents of the aerosol bomb and about three pints of spray had been liberated into the nest openings and on the outer envelope.

At that stage operations were temporarily suspended until nightfall. A tarpaulin was secured below and in front of the nest which was then pried loose from the palm and lowered to the ground. It was noted that the palm was light colored and clean where the nest had been. Apparently the insects removed all loose material so that the combs of the nest could be secured firmly to the solid wood.

Several dozen adult yellowjackets remained alive and much of the brood appeared to have survived the barrage of insecticide. The nest could not be placed in a museum so it was taken to the Honey Plant Gardens at the University of Florida and fastened to the trunk of a large oak tree. Adult insects continued to emerge for several days but after about two weeks the last survivors had disappeared.

Fig. 2.—A comb from the nest shown in Fig. 1 with queen cells in central portion.

In its central part the nest contained 17 levels of comb but only about half of the combs extended continuously from side to side. Although most of the combs were securely fastened to the palm at their inner edges, the nest was strengthened and braced by numerous pillars constructed between the combs. The outer wall of the nest was only slightly fastened to the combs, and it appeared to be largely self supporting.

A comb situated near the middle of the nest had many cells much larger than the others and we presumed that they were queen cells. This comb is pictured in Figure 2. An estimated 40 to 50 queens were found in the colony and a few males were noted. A few cells contained male pupae but no queen pupae were found.

About ten years earlier one of us (Tissot) helped to remove another large yellowjacket nest. It was located only one block from the campus of the University of Florida and it, too, was built on a *Phoenix* palm. The trunk of that palm also was encased with a deep layer of ferns and decayed stubs of old palm fronds, but in that case the ferns were alive and growing.

The nest was only a few feet from the walk leading to the front porch and although no one had been stung the home owner was very anxious that the nest be removed. In this case the task was comparatively simple as the nest was only a few feet from the ground and easily accessible. To minimize the danger of being stung the nest was destroyed at night. A tarpaulin was put over the nest and drawn snugly around the trunk of the palm. A few ounces of carbon bisulphide were introduced under the cover and the nest was left until the next morning. At that time all the adult insects were dead and only a few larvae and pupae remained alive.

After the outer envelope was removed some measurements were made of the nest proper. This nest also followed the curvature of the palm trunk and the combs were fastened firmly to the trunk at their inner margins. The nest measured 24 inches horizontally and 12 inches vertically. The combs were about 10 inches wide from front to back. There were 12 levels of comb in the middle portion of the nest but only about half of them extended continuously from side to side.

The nest was dismantled and the area of comb containing brood was determined. It was estimated that from 25 to 30 thousand cells contained eggs, larvae and pupae. About a dozen queens and just a few males were found when the dead adults were examined. Specimens of the insects from this nest were identified as *Vespula squamosa* (Dru.) by K. V. Krombein.

The presence of another nest was suspected several weeks before it was found. In the spring of 1952 it became necessary to feed the bees at the Honey Plant Introduction Garden on the Agricultural Experiment Station Farm. The honey and water mixture which they were given was attractive to yellowjackets also and they entered the hives in large numbers. They were vigorously resisted by the bees and from 40 to 50 dead yellowjackets were found in some hives. The nest from which they came was found in June 1952 but the yellowjackets were not molesting the bees then so the nest was allowed to remain. It became necessary to feed the bees again in the fall. At that

time there were a number of queen rearing nuclei in addition to the full sized hives. Once more the yellowjackets began to rob the bees and this time their depredations were more serious as some of the nuclei were destroyed. To prevent further loss of bees the yellowjacket nest was removed on September 27, 1952.

The yellowjackets in this colony were conservatives which conformed more closely to the traditions of the genus. Their nest was made in a cavity in the earth where all published information indicates it should be. Late in the evening of the day before the nest was removed a little carbon bisulphide was poured into the nest entrance and a large sheet of craft paper was spread over the nest site to confine the vapor. There was no sign of life when the paper was removed the next morning and the nest was dug out for examination. The ground around the nest was level and the entrance was even with the soil surface. The doorway to the nest was a circular passageway one and one-half inches in diameter which led straight downward for a distance of about four inches. This passageway was lined with paper and at the top the paper extended outward on the surface of the soil to form a collar a little over an inch in width. At its lower end the entrance way led into the outer envelope of the nest and thus gave access to its interior.

When the soil above the nest was removed it was noted that roots of weeds and grasses penetrated the paper of the outer envelope. It was noticed also that the nest settled perceptibly when the soil was removed and it appeared that the roots supported it from above. This was verified later when it was found that the upper combs of the nest were securely fastened to the roots.

The nest was completely enclosed in the multiwalled paper envelope. Soil particles and other debris were embedded in the outer layer of the nest covering but the inner layers of the envelope and the combs were free of foreign matter except for the roots mentioned above. The nest was nearly circular in outline and flattened on the top and bottom. It had a diameter of 30 inches and the distance from top to bottom was about half as great. There were 13 levels of comb but none of the combs extended continuously all the way across the nest. All of the combs were being used for rearing brood. There were about 30 cells per square inch and by measuring the combs it was estimated that approximately 120,000 cells contained brood in

various stages of development. It was also estimated that the colony probably contained at least 100,000 adults. The sixth and seventh combs from the top had numerous large cells which had been used for rearing queens.

Approximately half of the dead adults were taken to the laboratory for examination. The vast majority were workers but nearly a hundred queens and a few males were found. An examination of the combs failed to reveal any queen or male pupae. Mr. Krombein identified specimens from this nest as *Vespula squamosa* (Dru.).

Fig. 3.—Nest in a rolled rug in a garage.

An interesting nest which shows the versatility in nesting behavior of Florida yellowjackets came to our attention December 17, 1952. Another Gainesville resident reported that "hornets" had made a nest in her garage and she asked how they might be destroyed. We found in this case that a colony of yellowjackets had utilized a man-made structure for their nest site. A rolled-up rug had been suspended overhead in the open garage and the insects had made their nest in the end of the roll nearest the front of the garage. The gable of the garage was enclosed to the top of the door opening. The outer end of the rug roll was slightly lower than the bottom of the gable wall

and the rug was nearly touching the inside of the wall at its lower edge. The exposed parts of this nest are shown in Figure 3. At its outer end the opening in the roll had been closed by a paper wall with an opening near its center. The paper was extended upward and attached to the wood of the garage for a distance of four or five inches. On the lower side of the roll about two feet from the end, the insects had constructed a shield-like paper structure. This was about a foot long and eight inches wide and there was a slit-like opening along its central keel which served as an entrance for the yellowjackets.

It was a rather cool day when the nest was removed and though a few yellowjackets were leaving and returning to the nest their flight was slow and their movements sluggish. The rug roll was hung from cross supports of the garage with pieces of sash cord. Two of the cords at the front were loosened allowing that part of the roll to swing downward. Some chloroform was poured on the end of the rug containing the nest and the rug was quickly wrapped in a large plastic sheet. The rest of the supporting cords were then loosened and the nest was taken to the laboratory for examination.

As we began to unroll the rug it was noticed that a circular hole about three inches in diameter had been cut just above the center of the shield-like structure mentioned above. The circular opening extended inward to the center space of the roll. Protruding downward into this opening and almost filling it was a circular comb composed entirely of large queen cells. When the rug was unrolled further it was found that another circular hole of about the same size had been cut through all but the outer layer about eight inches nearer the front end. This opening likewise contained a round comb of queen cells. After the rug was completely unrolled it was noticed that a fairly large area of the innermost layer had been cut away. An oval shaped comb about six inches long, composed of small cells, occupied this space. Attached to one end of this comb was the first mentioned queen cell comb. The space in the roll above the small combs was occupied by two larger combs of nearly equal size and shape. These combs were about sixteen inches long and about four inches in width at their widest point. They were shaped somewhat like a long narrow shoe sole. They contained only small brood cells.

The combs were fastened to the rug by a single small attachment. This was located about in the middle of the upper comb

and it must have marked the point where the queen mother built the first cells when she founded the colony. Elsewhere the combs were separated from the rug and partially supported by a layer of paper a half inch or more in thickness. The front ends of the combs were about a foot from the end of the roll and the intervening space was filled with curved and twisted layers of paper which formed a number of tortuous passageways.

An examination of the paper of the nest revealed that the yellowjackets had incorporated a little of the rug material in the paper. Apparently this was not suitable building material for most of it had been discarded. Some had been thrown out and dropped to the ground but the greater portion had been dumped in the open space in the rug roll beyond the nest.

This was one colony where we were able to obtain an accurate census of the adult inhabitants. A few of the insects were afield when the nest was removed but probably not more than twenty-five individuals were thus lost. Fourteen queens were found. One was obviously the founder of the colony for her wings were tattered and so reduced in area that they could not possibly have supported her in flight. The remaining population consisted of 1,013 males and 372 workers. An examination of the queen cells indicated that we should have found sixteen young queens for there were that number of empty cells from which queens apparently had emerged. Presumably the three missing ones had left the nest to hibernate elsewhere or they may have fallen prey to natural enemies. The comb with the empty queen cells had 34 additional large cells already capped. These contained pupae in various stages of development and a few fully formed adults ready to emerge. The other queen cell comb contained 50 capped cells and both combs had an undetermined number of open cells containing queen brood in all stages of development from eggs to fully grown larvae. It seemed probable that a few weeks later this colony would have included more than 100 queens. All of the small brood cells which had been capped contained male pupae. Although the earlier stages could not be definitely identified as males it seems probable that only sexual forms were being produced when the nest was removed.

A comparison of the insects from this nest with those from the other colonies showed that they too were *Vespula squamosa* (Dru.).

Although we were told that the rug had been in the garage for two or three years it seemed likely that the colony had been founded the previous spring. Later information proved that the nest actually was started much later than we supposed. The owner of the garage called a few weeks after the nest was removed and said that the rug had been taken down about July 1, 1952, and that it was partly unrolled and a piece cut from it and then hung up again. A part of the rug was missing when we examined it and certain events made it possible to time its removal quite accurately. If there had been even a small nest in the rug then it surely would have been noticed so it seems certain that the nest was less than six months old when we removed it.

We learned of the most amazing nest of all in June 1952. H. O. Harrison, Agricultural Agent for Dixie County, Florida, told us that he had heard of the nest a few weeks earlier and that he had gone to see it. The description he gave and his estimate of its size sounded fantastic and we determined to see the nest ourselves.

The nest was located in the extreme southwestern corner of Lafayette County about 200 yards from the Dixie County line. It was on the west side of State Highway 51 just three miles from its junction with Highway 19, on land belonging to the Buckeye Cellulose Corporation of Foley, Florida.

On June 30 we visited the nest site and it was at once evident that Mr. Harrison had been very conservative in his statements. In one respect, however, we found conditions different from the way he described them. The nest was only a few rods from the paved highway and the yellowjackets were said to fly into cars and sting people passing by. We reached the nest about the middle of the forenoon on a warm, bright day. Hundreds of yellowjackets were leaving and returning to the nest and many of them flew low across the highway but they took no notice of us. It was realized that the colony had great stinging potentialities so we played safe and donned bee veils and protective clothing before proceeding with our observations and picture taking. A ladder was placed against a tree about 15 feet from the nest to get a close-up picture. We went up the ladder several times, walked all around the nest, and took pictures directly under it. Though an occasional insect flew around us they made no serious attempts to sting and this colony like

the others failed to uphold the yellowjackets' reputation for pugnacity.

George B. Everson, Jr., staff writer for the Florida Times-Union, also had heard about the nest and when he learned that we had seen it and made pictures he asked us for an interview. His story, illustrated with a close-up picture of the nest, was featured in the Sunday, July 6, issue of the Florida Times-Union. This story attracted the attention of entomologists as far away as New York and California. Dr. Herman Gunter, Director of the Florida Geological Survey, also became much interested in the nest and expressed a desire to secure it for the Survey Museum if possible.

One can think or tell about this nest only in terms of superlatives. At first sight it gave the impression of being a gigantic unopened toadstool or perhaps the thatched stilt house of some aboriginal tribe. Figure 4 shows the nest as seen from the road. When seen in full sunlight it had a silvery gray appearance. In shadow it appeared a darker, duller gray. It towered high in the air and its rounded top was a full 30 feet above the ground. The pine tree which supported it was broken off sometime in the past, probably by the wind. No vestige of the top remained to give a clue as to when the tree was broken. The top of the broken trunk was completely hidden within the nest.

The nest was roughly cylindrical in shape with a rounded dome-like top. At the bottom there was a sort of ruff or frill extending downward around the tree trunk. The nest proper measured 9 feet from top to bottom and the ruff extended a little over a foot, giving an overall length of a little over 10 feet. At its widest point the nest had a circumference of 9 feet 10 inches. There were no well defined entrances but the inhabitants went in and out of the nest almost anywhere between the over-lapping sheets that formed its outer wall.

In addition to the large nest we found some smaller ones which presumably were outposts of the main colony. One was at the base of the nest tree and it extended into a cavity in the trunk at the ground level. Another was a small cone-like structure on the ground a few feet away. A third was hidden beneath a palmetto leaf and a fourth and fifth were fastened to the trunk of another pine tree nearby. When we again visited the nest site early in December 1952, the small nests had disappeared. Some charred remains indicated that they had been burned and

Fig. 4.—Yellowjacket nest on trunk of broken pine in Lafayette County, Florida.

the destruction must have been deliberate as the surrounding woods did not appear to have been burned.

There was a great contrast between the condition of the nest and its inhabitants as we first saw them in June and as they were in December. In summer the colony was a bustle of activity as hundreds of yellowjackets left the nest or returned from foraging expeditions. The nest itself had a neat and tidy appearance and its walls were in good repair. In December the insects were pathetically few and their flight was faltering and irresolute. Gaping holes appeared in the walls of the nest, particularly on the side facing the road. It appeared obvious that the colony could not survive the winter.

As the colony seemed doomed it was decided to remove the nest for examination and study and to secure specimens. We went to the nest site on February 6, 1953 and were joined there by Dr. Herman Gunter and Andrew R. Janson of the Florida Geological Survey. We were equipped with ladders, block and tackle, saws, and other paraphernalia for cutting the tree and lowering the nest gently to the ground. The tackle was secured between the nest tree and a neighboring pine. After sawing the tree it was slowly lowered until the nest was suspended in a horizontal position within easy reach. A half pint of chloroform was poured along the upper side of the nest which was then wrapped with a large canvas. In about fifteen minutes it was deemed safe to remove the cover and begin exploring the nest. Measurements proved that our earlier estimate of the size of the nest was surprisingly accurate.

After some discussion it was decided that a lengthwise cut would best reveal the internal structure of the nest. A sharp machete was used to cut out a wedge-shaped section reaching in to the tree trunk and extending from top to bottom of the nest. Later, more of the nest was sliced away until only half of it remained attached to the tree. The section thus exposed is pictured in Figure 5. This shows the arrangement of the combs and it also reveals that all of them sloped slightly downward. None of the combs was continuous around the nest but they were made in sections which met irregularly and often overlapped. This made it difficult to determine accurately the number of layers of comb in the nest. Neither were the combs continuous from top to bottom. The picture shows that they were arranged in three groups, separated from each other by areas of loosely

constructed paper. The lower group contained 39 levels of comb, the middle group had 29, and the upper group only six.

We started removing combs from the bottom of the nest and worked toward the top. Each comb was examined carefully as it was taken from the nest. There was no living brood in any part of the nest. Most of the combs contained only small cells but the 13th, 14th, 35th and 36th combs from the bottom each had an area of large queen cells near its attachment to the tree. No queen cells were found in the middle group of combs. A few small clusters of queen cells were attached to the lowest comb of the upper group but apparently they never were used as there was no sign of the meconium layer which should have remained if queens had developed in the cells. Only half of the nest was examined but there was no reason to believe that the other portion varied greatly from the part that was removed.

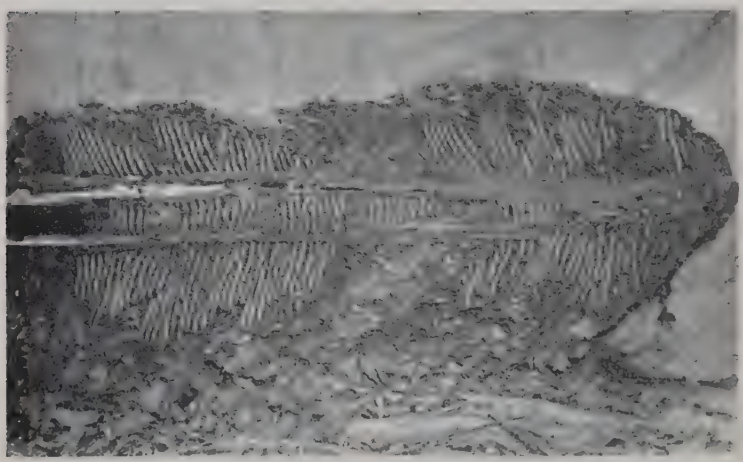


Fig. 5.—Longitudinal section through nest shown in Fig. 4.

The remaining portion of the nest was separated into two parts by sawing the tree trunk just below the middle group of combs. The upper part was taken to Tallahassee for display in the Florida Geological Survey Museum. The lower portion was deposited in the Florida State Museum in Gainesville.

Several unexpected discoveries were made during the removal of the nest. Perhaps the most surprising of all was the condition of the tree itself. From our first visit we assumed that the tree was dead. As the first saw cut was made the

copious flow of sap from the trunk and stump showed without doubt that the tree was alive though it possessed neither branches nor needles. The most plausible explanation of this phenomenon was that a natural root graft had developed between the tree and its near neighbor.

Another surprising feature was the small number of yellowjackets in the nest. Twenty-seven queens and 114 workers were found in the part that was dismantled. Some of the insects were afield when the nest was removed and perhaps as many as a hundred of these returned and flew about where the nest had been. The entire population probably numbered between four and five hundred individuals.

It was hoped that the internal structure of the nest might give some indication of the age of the colony. Few tangible clues were found and no definite conclusions were reached. The upper part of the tree trunk was hollow and it seemed fairly certain that the original nest was built within this cavity. It was not possible to determine whether the colony had been established before or after the top was broken off. Neither could we tell if the three portions of the large external nest were the same or of different ages.

The arrangement of the combs in three regions was puzzling but a possible explanation was found in the two small nests which we noticed on the lower trunk of the neighboring pine in June. They were on the same side of the tree and one was about 18 inches above the other. If they had not been destroyed the insects might have extended these nests around the tree as well as downward. As the inhabitants of the upper nest built their combs downward they soon would have encountered the upper edge of the outer envelope of the lower nest. It seems logical that instead of removing this and intruding on their neighbors they would have added paper of their own and filled in the intervening space. This would have resulted in a structure much like that of the large nest described and pictured above.

We can only surmise the causes that brought about the rapid decline of the colony, but a few things were noted which may be significant. The nest was in good repair on our first visit though we noticed numerous tiny holes in the outer envelope on the side nearest the road and an empty shotgun shell was found near the roadway. A considerable area around the nest was strewn with wooden stakes, empty bottles, stones, and

other objects which obviously had been thrown at the nest. Such a conspicuous object no doubt made a tempting and irresistible target for passersby who sought a thrill or were merely bent on destruction.

As the nest was dismantled we found evidence that a great many of the missiles had found their mark. Holes in the outer envelope showed where the larger objects had entered the nest. A dozen or so stones varying from pebbles to chunks weighing a pound or more were found in the outer envelope or lodged deep between the combs. Many of the combs were pierced or grooved by smaller, faster moving objects. Most of these had passed all the way through the nest but a number had lodged against or embedded themselves in the wood of the tree. No effort was made to find all of them, but several dozen shotgun pellets were noticed. These varied in size from number eight birdshot to large buckshot. Several .22 rifle bullets and .38 caliber revolver slugs also were found. Without doubt these missiles killed a number of the insects and some of these may well have been queens. Indeed, a number of dead and mutilated queens were found in the nest, but they could have died from natural causes. Whether the forces of nature or the acts of man brought about the death of the colony will remain an unsolved mystery.

A farm family living about two miles from the nest site told us about another large nest that they had found deep in a dense swamp. They stated that it was built near the ground and that it possibly surrounded a large tree stump. It was their opinion that this nest was even larger than the one on the broken pine but no measurements were made and its size could not be verified. The nest appeared to be deserted when they last saw it and as the swamp was said to be almost impenetrable we did not try to visit the nest. There were rumors of still another large nest in the vicinity so it seems likely that big yellowjacket nests are common in that part of Florida.

A news release describing the removal of the nest was widely distributed by the Associated Press Service. As a result of the story we received letters and comments from widely scattered places. Information given by one correspondent was so interesting and relevant that we report it here.

Mr. L. L. Ferebee of Tillman, South Carolina, wrote about two large yellowjacket nests which he saw in the extreme southern tip of that state in 1922. He remembered distinctly that

he visited the first nest about the middle of June and the other in September. Mr. Ferebee owned a large apiary then and a neighboring farmer asked him to remove the honey from a "bee tree" that he had found across the Great Swamp from Hardeeville. Mr. Ferebee's discription of what he found and saw is so vivid and realistic that it seems fitting to quote directly from his letter. "When we got there and I took one glance, I realized instantly there was not a bee anywhere around, but yellowjackets equal to 40 colonies of bees. The thing was approximately forty feet of yellowjacket nest, starting about 11 feet from the ground, on a dead and partly rotten tree probably 75 to 80 feet high. The diameter of the nests plus about two feet of tree seemed to average about 40 to 55 inches, and was in bulges, which gave the apparent average thickness of the nests from about 8 to 18 inches. Many young yellowjacket queens were in evidence and I probably saw 50 to 100 flying about." From this description it seems evident that the structure of the nest must have been like that of the one we studied except on a much grander scale. It appears significant that he emphasizes the bulges in the nest and these probably mean that the combs were not continuous but more likely were arranged in a number of separate groups. It is interesting to note also that queens were so numerous in early summer.

The second nest that he told about was found on Colleton Neck about five miles south of Parris Island Marine Base. It was built over an old oak stump but apparently rested on the ground also. He describes it as approximately 11 feet long, 4½ feet high at the peak, and about 6 feet wide at the ground.

Mr. Ferebee's letters indicate that he is a careful and accurate observer and his descriptions of the nests and estimates of their size are without doubt entirely trustworthy. He wrote that in his youth he tended cattle and sheep in the woods and that in middle life he spent many years as a practical forester. He mentioned that he also hunted deer and turkeys extensively. Although he found many yellowjacket nests in the ground, the two described above were the only ones that he ever found above ground.

Once again, in the spring of 1953, we were called upon to destroy a yellowjacket nest for another Gainesville resident. This time the nest was found within the house and the insects were extremely troublesome to the people living there. A diagonal wall had been built across the angle of an ell of the

house and this made an enclosed triangular passageway joining the two rooms of the ell. This passageway had a low ceiling just above the top of the doors and the sloping roof was of sheet metal. The nest occupied the space under the roof and as it was on the southeast side of the house and exposed to full sun the temperature must have been extremely high beneath the metal roof.

The insects entered the nest through a crack just beneath the lower edge of the roof and also at one side where the siding did not match well. Some paper had been attached to the side of the house but there was no comb on the outside. On the inside of the passageway, there was a narrow crack at one edge of the ceiling and through this the yellowjackets made their way into the house.

On the night of May 18 we sprayed the entranceways of the yellowjackets thoroughly with two percent chlordane household spray. Then a one-inch hole was bored in the ceiling so that spray could be driven directly into the nest space. Immediately after the bit went through the wood about a dozen mad yellowjackets poured out of the hole and in an instant several had used their stings to good advantage. After applying a liberal amount of spray we plugged the opening and left the nest until the following evening. At that time there were a few living insects but they offered little resistance. More spray was applied and a week later there was no sign of life.

It would have been very difficult to expose the nest so we contented ourselves with examining the insects that crawled into the passageway and died there. We found 12 queens, three males and a large number of workers.

For a long time we have had a desire to watch a yellowjacket colony develop and grow. In July 1953 we inadvertently lost an opportunity to do so. This colony was reported to have its nest in the ground and the insects were said to be very aggressive. We visited the site after dark and the entrance of the nest was pointed out. A quantity of carbon bisulphide was poured at the entrance and the nest was covered with a large piece of craft paper and left until the following morning.

To our surprise we found only a very small and apparently newly established colony. The nest contained a single oval comb about an inch and a half long by an inch and a quarter wide. It was located amid the litter of leaves and twigs on the surface of the ground. It was not enclosed in an envelope but

was protected above by a loosely constructed cover of paper.

The adult inhabitants of the colony consisted of one queen and 11 workers. The comb contained 18 capped cells with pupae, 10 cells with larvae, and eight cells with eggs. Each of two cells contained both a larva and an egg and one cell contained three eggs. The queen was of normal size but the workers were unusually small for the species. This nest gives further evidence that it is quite normal for yellowjacket colonies to be founded in midsummer in Florida.

Some of the features of biology and behavior discussed in this paper are different from those usually attributed to yellowjackets. It generally is stated in the literature that colonies of hornets and yellowjackets endure only a single season. Michner and Michner in their book *American Social Insects*[2] state that males and young queens leave the nest before the breakdown in social behavior of the workers which marks the end of the colony. They add that the workers stay with the nest and die off one by one until all are gone and only the hibernating queens remain to carry on the species. They state further that in warmer climates a nest may occasionally survive through the winter and then produce sexual forms in the spring. They do not tell what the fate of these late-produced sexual forms may be but from their other statements it would be surmised that the young queens leave the old nest and establish new colonies.

Although we have no conclusive proof, we believe that yellowjacket colonies in Florida sometimes are perennial and that they may remain continuously active for several years. The nest in the palm which was removed in June, 1951, was first noticed the previous Thanksgiving. It is not known whether it remained active through the winter. The numerous daughter queens in this nest must have been produced the previous fall or perhaps in the spring and they may have remained in the nest and possibly they aided the mother queen with the egg laying.

The extremely large size of some of the nests is further evidence that the colonies are perennial. This may indicate that they consist of the offspring of several queens. It is inconceivable that a nest ten feet long, and a yard across, could have been built in a single season even through the combined efforts of several queens. The thriving outpost nests which

[2] D. Van Nostrand Company, Inc., 1951.

we found below the large Lafayette County nest in June very likely were ruled by some of the daughter queens from the parent colony.

It is commonly believed that yellowjacket colonies are founded in the spring and that may be their usual behavior in most places. However, the nest in the rug which almost certainly was started after the first of July and the small nest which also was found in July give very good evidence that daughter queens may leave an old colony almost anytime to start new ones.

Vespula squamosa (Dru.) is reported to nest only underground or rarely just above the surface. Five of the nests described here were aerial and one was twenty feet from the ground. Subterranean nests also are common here so this species evidently is much more versatile in its nesting habits than was formerly believed.

This discussion would not be complete without some mention of the paper of the nests. All of the nests studied had the same general coloration and appearance irrespective of their locations or the situations in which they were found. Pieces of paper from the outer envelopes of the nest on the Phoenix palm in Gainesville, the one dug from the ground at the Honey Plant Garden, and the large nest on the broken pine in Lafayette County are scarcely distinguishable one from the other when they are placed side by side. In every case the paper of the envelope has a brindled appearance with more or less curved streaks of various colors. The streaks shade from white through creams, yellows, and light browns to dark rich tobacco browns. There are also streaks of gray of various shades and quality. The paper used in making the combs always is a uniform dark dull gray. It is generally darker than the darkest streaks in the nest envelope.

A number of other colonies of yellowjackets have been observed during the past two years but they have not shown any features of structure or location different from those already described. We plan to observe and study other colonies whenever opportunity offers in the hope that they may cast light on some of the unanswered questions relative to these interesting insects.

EFFECT OF GROUND AND SPRAY APPLICATIONS OF ZINC COMPOUNDS ON INFESTATIONS OF PURPLE SCALES

HERBERT SPENCER, MAX R. OSBURN and PAUL A. NORMAN [1]

In 1947 it was the practice to remedy zinc deficiencies in citrus trees by spraying them with zinc sulfate plus hydrated lime. Symptoms of frenching chlorosis called for a spray containing 4 to 5 pounds of zinc sulfate plus 2 to 2½ pounds of hydrated lime per 100 gallons of water. For other citrus trees the recommendation was a maintenance spray containing 3 and 1½ pounds of the respective materials each year (Florida Citrus Commission, 1947).

Heavy inert spray residues on the leaves and fruits of citrus trees are objectionable, since heavy infestations of purple scales (*Lepidosaphes beckii* [Newm.]) and other pests often follow their use (Osburn and Spencer, 1939. Spencer, 1939). The use of other available zinc compounds that are safe for foliage and require no lime for neutralization might result in fewer purple scales, since these compounds would leave less residue on the leaves. Ground applications of zinc might avoid residue build-up entirely. Also, more information was needed on the degree of scale infestation that would follow their use.

Since the problem was horticultural as well as entomological, an experiment was planned in cooperation with the Orlando, Florida, Laboratory of the Bureau of Plant Industry, Soils, and Agricultural Engineering.[2] That laboratory studied the effects of the treatments on the trees, and the authors the effects on the insects. This paper reports the entomological results.

A grove of 324 young Hamlin orange trees on rough lemon roots was selected early in 1947 for this work. The trees had been planted in virgin land 5 years before, and neither the ground nor the trees had ever received any applied zinc. For the experiment the grove was arranged in 10 blocks of 13 trees each. Buffer rows of trees were left on the roadside and between

[1] United States Department of Agriculture, Agricultural Research Service, Entomology Research Branch.

[2] Cooperating project workers of the Bureau of Plant Industry, Soils, and Agricultural Engineering were Walter Reuther, Paul F. Smith, and George K. Scudder, Jr.; grower cooperators were Werner Husmann and A. N. Fox of the Apshawa Groves, Minneola, Fla.

the experimental blocks to make sure that spray drift and cross feeding of roots would not affect results. Seven different treatments, as given in Table 1, were applied in each block of trees. The amounts of material were calculated to give each tree that got zinc the same amount of elemental zinc.

The sprays were applied to single-tree plots in each block. A 400 or 600-gallon power sprayer was used with one lead of hose and an orchard-type, spray gun. Enough spray was applied to cover all parts of the trees thoroughly. The ground applications were made to three-tree plots, and the middle tree was used in obtaining data. The material was spread by hand, like fertilizer, the quantity of zinc being measured for each tree. Applications were made each year for 5 years—on March 4, 1947, February 18, 1948, April 27, 1949, March 1, 1950, and April 25, 1951.

The grower cooperators followed their usual rust mite and red mite control program, but agreed to put on no zinc or scalicide in this grove during the experiment. In the midsummer of 1948 scale-insect infestations had reached a high level, and for protection of the trees and the crop all trees were prayed on July 22 with 1.25 percent oil emulsion. By 1950 infestations had again become very high; so on September 14 all trees were sprayed with 2 pounds of 15 percent wettable parathion plus 5 pounds of wettable sulfur per 100 gallons. At the conclusion of the experiments a spray containing 2 pounds of 15 percent wettable parathion per 100 gallons was used to clean up the remaining scales.

The effects of these treatments were determined by cutting off 20 leaves at chest level around each tree and examining them under the binocular microscope for living purple scales.[3] Numbers found on half the upper and lower surfaces of each leaf were recorded separately. These data were summarized for each sampling date and for each treatment, and statistical analyses made. During the 5 years eight sets of samples were examined, with the results shown in Table I.

The data usually showed higher infestations following the zinc sulfate plus hydrated lime spray than after the zinc oxide or zinc carbonate sprays. After the zinc sulfate plus lime spray, increases over the check were significant statistically in 3 of the 5 years, and highly significant in 1 year (1950). However, increases from zinc carbonate and zinc oxide were slight and

[3] Bernard W. Knecht assisted in examining the leaf samples.

TABLE I.—Effects of Spray and Ground Applications of Zinc Compounds on Purple Scale Infestations.

Treatment	Mean Number of Living Purple Scales per Leaf					
	1947		1948	1949	1950	1952
	Mar. 3*	Nov. 25	June 1	July 22	Aug. 31	Jan. 30
Check	4.17	7.19	10.66	1.08	31.03	24.86
Spray (Pounds per 100 Gallons)						
Zinc sulfate (36% zinc) 3 + hydrated lime 1½	3.57	9.09	16.27	2.44	62.42	38.18
Hydrated lime 1½	4.41	7.09	13.67	2.14	43.46	25.87
Zinc oxide (80% zinc) 1¼	3.28	7.80	10.36	1.38	41.92	29.43
Zinc carbonate (52.3% zinc) 2	3.94	8.99	16.16	.79	40.20	30.42
Ground Applications (Pounds per Tree)						
Zinc sulfate ½	4.09	7.58	17.43	.87	35.88	26.23
Zinc carbonate pellets ⅓	3.08	6.72	9.82	1.14	39.59	27.26
Difference required for significance:						
at 5% level	ns **	ns	5.57	app.**	18.87	ns
at 1% level	—	—	7.43	—	25.17	—

* Before first applications.

** ns = not reaching 5% level; app. = approaching closely 5% level.

nonsignificant, except in 1948 when the carbonate series was significantly higher. The presence or absence of zinc did not seem to be the factor affecting the magnitude of the infestation, but rather the total amount of deposit. All the ground applications gave results statistically equivalent to the checks except in 1948, when zinc sulfate gave higher infestations.

Although no spray burn was caused by the zinc sprays in this experiment, zinc oxide may cause burn if sprayed on trees carrying young fruits and tender, new growth. Zinc carbonate can be used safely. Zinc carbonate or zinc oxide used without lime usually resulted in fewer purple scales than zinc sulfate plus hydrated lime. Ground applications of zinc sulfate resulted in fewer purple scales than spray applications of zinc compounds.

LITERATURE CITED

Florida Citrus Commission. 1947. Better fruit spray and dust schedule for 1947 season. 10 pp. Lakeland, Fla.

Osburn, Max R., and Herbert Spencer. 1939. Effect of spray residues on scale-insect populations. Jour. Econ. Ent. 31(6): 731-732.

Spencer, Herbert. 1939. Increases in citrus scale-insect infestations from heavy residues and from copper spray mixtures. Jour. Econ. Ent. 32(5): 686-688.

MALATHION FOR HOUSE FLY CONTROL

HERMAN S. MAYEUX [1]

Numerous chemicals and methods have been tested by various workers against house flies (*Musca domestica* L.) during the past several years in an effort to find suitable control measures to replace the chlorinated hydrocarbons, DDT and related compounds, to which the house fiy has developed a high degree of resistance in most locations. Among the chemicals and methods tested and/or proposed, the use of baits and sprays containing organic phosphate insecticides have appeared to be the most acceptable.

Results with sprinkler-can applications to floors of baits containing tetraethyl pyrophosphate were reported by Thompson et al. in 1953, and widespread use was made of TEPP baits during that year. However, the mammalian toxicity of TEPP is rather high and the residual action is very short.

Malathion (o,o-dimethyl dithiophosphate of diethyl mercaptosuccinate), an organic phosphate compound much less toxic to mammals than either TEPP or parathion, was applied to dairy barn floors at 0.1 percent strength with 10 percent sugar or molasses in water by Gahan et al. (1954) and gave better control than 0.1 percent TEPP with 10 percent molasses; however, daily applications were needed for up to two weeks where breeding was heavy. Similar good results were obtained by Gahan on a garbage dump at Orlando, Florida.

A schedule of daily applications is often difficult to maintain and following the work by Thompson et al. it was believed desirable that chemicals be tested to find a form of bait that would be active for longer than one day.

PRACTICAL TESTS AGAINST ADULT FLIES

The writer conducted a series of practical experiments during 1953 against flies in the north Florida and south Georgia

[1] Entomologist, Florida Agricultural Supply Co., Division of Wilson & Toomer Fertilizer Co., Jacksonville, Florida.

The writer wishes to acknowledge assistance by Julian H. Jackson, Chemist, and William J. Head, Assistant Chemist, Florida Agricultural Supply Co., in making chemical and physical analysis studies and James R. Christie, also of this organization, and Clyde Flynn, Jacksonville Board of Health, who assisted in the field testing.

This paper was presented at the Georgia Entomological Society Meeting, Athens, Georgia, March 13, 1954.

areas. Preliminary work in 1952 showed that a bait composed of 1 pound of 25 percent dilan wettable powder mixed into 2½ gallons of blackstrap molasses was very attractive to adult flies and was effective in reducing fly populations in caged laying hen houses. Although effective, the dilan bait was slow to kill and lacked the spectacular fast-killing power of the TEPP baits then in experimental use.

In 1953 malathion was substituted at the rate of one pound of 25 percent wettable powder per 2.5 gallons of blackstrap, or approximately 1 percent malathion in the finished bait. The bait was very attractive to adult flies. Flies became affected and began dying two to three minutes after starting to feed upon the bait during warm, summer weather. When the temperature was 50 degrees F. or lower, the flies became affected in five to ten minutes, depending upon the temperature.

In chemical laboratory tests it was determined that the finely divided powder settled none at all or extremely slowly in liquids such as molasses, syrup or honey having a density of 42 degrees Baume or higher.

Field testing showed that after storage for several weeks, some of the baits required a longer time to kill. Chemical analysis showed that the malathion was very gradually broken down, probably by hydrolysis, in the presence of moisture and impurities in the sweet materials. However, this gradual loss of toxicant did not prevent mixing a supply for use over a period of four to ten weeks. Furthermore the rate of loss varied greatly among different types of sweet materials.

The baits were very attractive when applied on double thickness burlap bagging or when "dribbled" in a narrow band on a hard surface in a manner to produce "plenty of shore-line" for the flies to stand around. Flies would soon light directly upon the bait as it soaked into burlap but were distinctly wary and definitely repelled from puddles of bait onto which their legs and wings might become stuck. For this reason shallow pans of bait were very unsatisfactory as were puddles of bait upon hard surfaces.

The active life of the baits depended upon the length of time required for the flies to consume the material and on the time required for the bait to dry out. Once the baits became dry and hard they lost much of their original attractiveness.

Comparisons were made of various sweet bait materials as to the rapidity of drying. The materials were smeared onto burlap and exposed in direct sunlight and in shade during both dry and humid weather. Blackstrap molasses dried within one day in direct sunlight but remained tacky and attractive for periods from two days up to seven days in shade depending upon atmospheric humidity. Sugarcane syrup and corn syrup were slightly better than blackstrap and produced less of the thin, skin-like film that commonly forms on the surface of blackstrap exposed to atmosphere. This film is believed to be the result of oxidation of impurities in the material.

Honey was definitely slower drying than any of the bait materials tested. The honey baits remained moist and attractive after as long as three weeks at which time a small amount of mold began to form. However, the baits killed flies during the entire twenty-one day period.

In June, 1953, three widely separated caged hen houses were baited by hanging pieces of double-thickness, baited burlap at intervals of about 5 yards under the egg trough of each of the cages. The burlap pieces were approximately 12 by 18 inches in size and were framed to prevent rolling by sewing with a piece of haywire in about 4 inch stitches around three sides. The piece was hung just above the ground with haywire suspended from the egg trough. One of the houses was 170 feet long and 43 baits were used, a total of two gallons of bait material. Initial fly populations were 15 flies, 12 flies and 25 flies per square foot for the three buildings respectively. Populations were reduced to less than one fly per square foot within seven hours of daylight in all houses. Flies were still dying when the second application was made after seven days; however, the population was beginning to increase.

Several dairy barns were treated over a period of several weeks each. Baits were hung or laid at intervals about the buildings or wherever flies congregated. Six or eight baited burlap bags laid on the floor of the barn and two in the feed room were usually sufficient for fly control. During periods of dry weather, blackstrap baits were resupplied every three or four days but once a week was usually sufficient unless the baits were eaten away earlier.

Beginning in early June, 1953, there was a heavy population of house flies and blow flies at the Jacksonville, Florida City Garbage Dump and at the hog-feeding establishment asso-

ciated with the dump. Estimates of adult flies in the hog shed ranged from 300 to 2,500 per square foot. During the early afternoon a total of three gallons of blackstrap bait was applied on burlap and dribbled onto wooden and carboard surfaces under and around the shed. By noon the following day the ground under and around the building was practically covered with dead house flies and blow flies. By scooping up the flies at intervals it was possible to estimate at least 35 to 50 gallons of dead flies in the area.

After two days of baiting the population was reduced to an average of two or three flies per square yard. Migration from the garbage was heavy at all times; however, it was observed that the number of dying flies usually equalled the number of unaffected flies, indicating that the flies were being killed as fast as they moved into the baited area. After initial reduction was obtained three to six baits were kept active at all times for the next seven weeks. Baits were resupplied every three to seven days.

Beginning in late September there was a period of two weeks when no baiting was done. On October 15, there was an average of 54 flies per square foot based upon counts of live flies at ten points, one square foot at each point. An application was made in late morning using three pints of the malathion-blackstrap bait. One gallon was used in late afternoon of the same day and another gallon was used two days later. Table I shows the results during the first five days of the test period.

TABLE I.—RESULTS IN THE CONTROL OF HOUSE FLIES USING MALATHION BLACKSTRAP BAIT AT A HOG BARN NEAR GARBAGE DUMP.

Time	No. Points Examined	Average Flies/Sq. Ft. Alive	Dead	Percent Reduction
Initial	10	54	0	—
6 Hours	8	15	251	72
5 Days	14	1.4	1,136	90

Baiting was continued until late November when cool weather reduced breeding on the garbage.

On October 16, the fly population of a hog-feeding pen, situated about 200 yards from the garbage dump was estimated

to be in excess of a half million adults. The pen was baited at 2:00 P.M. with one gallon of bait smeared on four burlap bags, and bait was dribbled in a thin band onto a concrete slab that surrounded the fifty-feet-long feeding vat. After ninety minutes dead and living flies were counted at 20 points of one square foot each. There was an average of 15 live and 573 dead flies per square foot or a calculated total of 13,000 flies alive and 458,000 dead inside and around the pen, a reduction of 90 percent.

The garbage dump itself was baited on October 17 with ten gallons of bait applied to an area of 1½ acres. The bait was carried about the area in a ten-quart bucket, and the worker used a wooden paddle to sling the bait around over the garbage. Some of the bait was dribbled from the paddle onto cardboard and paper. There were at least two million flies present when the application was made. Flies began dying within three minutes as the bait was applied. The dump was observed after three days at which times flies were definitely under control and some were still being killed by the bait.

Additional tests were conducted in poultry houses where hens and broilers were kept on litter. These tests were in the Titusville, Florida, and Madison and Gainesville, Georgia areas. The baited burlap was particularly desirable in buildings having dirt or litter floors, such as poultry houses and cattle barns; whereas, the sweet baits that are diluted with water and are applied to floors were not satisfactory on litter or on dirt. They were also very short lived when applied to burlap and laid or hung about the area.

HOUSE FLY LARVAE EXPERIMENT

An experiment was conducted against fly larvae in a caged hen house using emulsifiable, malathion spray applied to the surface of the manure underneath the caged hens. The building was 100 feet long and about 28 feet wide with four cages, each four feet wide, extending the full length of the building. The cages were suspended about 3½ feet above ground level. Plots were 25 feet long and 4 feet wide, which was the width of the manure pile under each cage. Treatments were replicated three times with each cage having a replicate of every treatment.

The following treatments were used:

Treatment 1—1% Malathion emulsifiable spray (8 fl. oz. 50% Malathion per 3 gallons water) applied at 2½ qts. per 100 sq. ft.

Treatment 2—Spray containing Emusifiable Aldrin (2 lbs. tech. per gal.) at 4 fl. oz. per 2 gallons, applied at 7 qts. per 100 sq. ft.

Treatment 3—Untreated Check.

A total of one quart of manure was taken from ten different obviously infested mounds under each cage for a pre-application larval record. The manure was placed upon a piece of thin cardboard lying on 16 mesh screen wire held by an eighteen inch square wooden frame four inches deep. The material was then slowly washed through with a fine sprayer of water from a garden hose nozzle, and was manipulated with a trowel while being sprayed. Larvae were counted as they appeared on the screen and recorded as being alive or dead.

The initial counts were 510, 710, and 560 larvae for the three cages or blocks of plots respectively, an average for the house of 590 larvae per quart of manure. The applications were made during the morning of October 1, and the remaining manure in all four buildings of the poultry establishment was then treated with malathion spray and other malathion preparations against larvae and adults. The adult population was practically eliminated within a few hours.

After five days each plot was sampled by the same manner as described earlier. On this same date the plots were resprayed. The malathion spray was increased to 4 quarts per 100 square feet. The aldrin concentrate was increased to 8 fl. oz. per 100 square feet in 4 quarts of water. Plots were sampled again for larvae after seven days. Table II shows the results of this experiment.

There were more dead larvae and fewer live larvae in the malathion spray plots following the first application than where aldrin was used. By the time readings were made for the second application the overall larval population, including the untreated check, was reduced to almost zero as the result of controlling both larvae and adults in the entire establishment.

In another experiment in another house at the same location and at the same time, single plots were sprayed with emulsifiable malathion spray containing 0.5 percent and 0.25 percent malathion at the rate of 6 quarts per 100 square feet.

Five days after the application there were 111 dead and 35 live larvae per sample in the 0.5 percent treatment; 50 dead and 8 alive in the 0.25 percent treatment.

TABLE II.—AVERAGE NUMBER OF HOUSE FLY LARVAE DEAD AND ALIVE FOLLOWING ONE AND TWO APPLICATIONS OF SPRAY TO MANURE UNDER CAGED HENS.

Treatment	First Application		Second Application	
	Dead	Alive	Dead	Alive
Malathion Spray	92	33	12	14
Aldrin Spray	1	129	1	0.33
Untreated	2	83	0	3

SUMMARY

Tests were conducted during 1953 in Florida and Georgia against adult and larval stages of house flies in dairy barns, poultry houses, hog-feeding units and garbage dumps. Baits containing 1 percent malathion from wettable powder in honey, blackstrap molasses or syrup applied to burlap or in narrow bands on such hard surfaces as wood, concrete or cardboard were very attractive to adult flies and remained active for much longer periods than is claimed for similar baits that are diluted with water. Honey is definitely superior to blackstrap or sugarcane syrup because honey dries very slowly, if at all. Baits remained attractive from one to twenty-one days, depending upon the bait material used and atmospheric conditions.

Laboratory testing showed that settling of the wettable powder from thick baits of this type is extremely slow. The malathion content of baits was very gradually reduced upon storage; however, stored baits were effective for 4 to 10 weeks after mixing depending upon the material used.

In tests against fly larvae it was found that a spray containing one percent malathion from emulsifiable concentrate, applied to manure with a sprayer or sprinkler can at the rate of one gallon per 100 square feet was very effective against fly larvae and killed the adults that were contacted by the spray and many that later contacted the treated manure.

LITERATURE CITED

Gahan, James B., H. G. Wilson and W. C. McDuffie. 1954. Organic phosphorous compounds as toxicants in house fly baits. Jour. Econ. Ent. (in Press).

Thompson, R. K., A. A. Whipp, D. L. Davis and Edward G. Batte. 1953. Fly control with a new bait application method. Jour. Econ. Ent. 46(3): 404-9.

NOTICE OF ANNUAL MEETING

The thirty-seventh annual meeting of the Florida Entomological Society will be held at Bradenton on September 2 and 3. To make this meeting as successful as those held in the past, members are urged to make plans now to attend. Dr. Herbert Spencer, U. S. D. A. Laboratory, Fort Pierce, Florida, is program chairman. Titles of papers to be presented at the meetings should be forwarded to him in the near future. Dr. Spencer will also appreciate suggestions or help in the planning of the program.

EXPANDED MOSQUITO CONTROL AND RESEARCH IN FLORIDA [1]

J. A. MULRENNAN
Director, Bureau of Entomology, Florida State Board of Health
Jacksonville, Florida

In opening this address, it would seem appropriate to give credit where it is so justly due, because without the unanimous consent of the Florida Legislature some of the following remarks could not be made. Therefore, it can be seen that the mosquito control workers are indeed indebted to the thirty members of the Senate and the 79 members of the House of Representatives who voted for the new mosquito control law making it possible to establish a research center in the State to study arthropods of public health importance to give additional aid to counties for permanent control work. Not only are we indebted to the very able men in the 1953 Legislature, but an expression of humble thanks is in order for our great Governor, Dan McCarty, who was the first Governor in the history of the State to ever call the need for mosquito control to the attention of members of the Legislature, not only during the budget hearings, but also in his message to the Legislature. He pointed out the importance of mosquito control to the economy of the State and the great need for more direct aid to the counties as well as a stepped-up research program and the necessity for establishing a laboratory by the State Board of Health for the purpose of studying and developing better and more economical ways and means of controlling arthropods of public health importance.

In 1950 the State Board of Health adopted a policy in which they pointed out the status of mosquito control in the State and also recommended that every mosquito control district and county in the State appropriating a dollar for mosquito control should receive 75 cents from the State, the State funds to be used exclusively for eliminating breeding areas.

The Board also recommended that $200,000.00 be made available for research and technical assistance to the counties.

As you know, these recommendations became a reality during the 1953 Legislature in which a law was passed carrying

[1] Presented before the Florida Entomological Society at the 36th annual meeting, Miami, Florida, September 10, 1953.

an appropriation of $1,250,000.00 as direct aid to counties and mosquito control districts, the funds to be used exclusively for eliminating permanently the breeding areas of arthropods of public health importance by draining and filling.

In addition to the appropriation for permanent work and in order to administer the provisions of the Act, to assist districts and counties with technical and administrative problems in complying with the Act in an effective and economical manner and for the purpose of research in developing more effective means of arthropod control, the Legislature appropriated $250,000.00 annually to be expended by the Board for the establishment, equipping, maintenance and operation of a research laboratory and facilities incident thereto.

There is no question but what arthropods of public health importance were the greatest stumbling block to the early development of the State. Before the turn of the century, yellow fever caused panic in the State, dengue fever would spring forth every few years to take its toll and malaria remained a constant yoke around the necks of practically all citizens in the northern and western part of the State. The control of these mosquito-borne diseases in the past 20 years has led to expanded development in the State which is now coming to the forefront with each year finding an ever-increasing number of permanent residents as well as more tourists each year finding their way to the sunshine State.

In the past fifteen years it has been brought to the attention of the people of the northern States that it was possible to come into the southern part of Florida during the winter months and not run the risk of succumbing to a mosquito-borne disease or being chewed on by pest mosquitoes during this time of the year. This northern influx of tourists each winter has built up to the point where last winter (1952-1953) nearly 4,000,000 people visited the State and it is anticipated this winter that around 5,000,000 will visit the nation's winter play grounds. The last two years have seen a decided increase in summer visitors. In 1952 it was estimated that around 1,000,000 summer tourists visited the State and it is expected that there will be a greater increase than the previous summer. While in 1952 the total number of visitors to the State was around 4,950,000 and it is expected that the number may reach the 6,000,000 mark during the 1953 season. This means increased income to the citizens of Florida and whereas

in 1952 it was estimated that $900,000,000.00 was contributed to the State by the multitude of visitors, all evidence at the present time points to a figure for 1953 to rise to well over the billion mark.

The protection of the health and the comfort of the visitors is in itself a humanitarian expression of service but for the static populations it is not only a humanitarian gesture, but it is an economic necessity for the survival of an ever-increasing high standard of living which has been brought to the citizens of Florida in the past few years.

There are those who would lead you to believe that the control of arthropods of public health importance such as mosquitoes, sand flies, dog flies, house flies, yellow flies and other arthropods annoying man is a very simple and easy task to accomplish. Just how simple is the job? Well, did you ever fly over Florida and especially over the 10,000 islands, then over the Florida Keys and come back through the central part of the State to Jacksonville and leave for Pensacola flying over the vast number of gum swamps in West Florida? If you had made the trip last week, I can assure you of one thing—that you would have seen rivers out of their banks, swamps that were flooded, ponds, lakes and temporary marshes that were flooded to the brim. To the average individual this would mean flooded conditions brought about by heavy rainfall. To the individual who is familiar with some of the habits of the 67 different species of mosquitoes found in the State it would mean extremely heavy mosquito production. Flood water produces mosquitoes, regardless of whether this water is caught in a tin can, collected in the leaf bases of a bromeliad, the overflow from a swamp, high tides over a coastal marsh, or water lettuce growing prolifically in a canal—all spell mosquitoes by the billions; and when all factors are in balance for a heavy production, mosquito populations are produced on a scale to stagger the imagination of the human mind.

It would be hard for you to believe that this spring the egg counts of salt-marsh mosquitoes on some of the islands off the western coast of Florida were found to be an average of 12,000 eggs per square foot of soil or over one-half billion eggs per acre. It has been estimated that there are approximately 700,000 acres capable of producing this fabulous number of salt-marsh mosquitoes. All that is necessary to bring forth these massive broods is to flood the marshes, swales and de-

pressions near the coast with water from high tides or by heavy rainfall. What does all this mean? Exactly this: if there is located adjacent to a town fifty acres of the above type of breeding area, it would be very easy to bring forth at one emergence 25 billion mosquitoes. Suppose that the town covered five hundred acres, and that one-half of the mosquitoes were females, this would mean that distributed over one acre of land in the town you would have 25,000 female salt-marsh mosquitoes making life miserable for any individual having nerve enough to stick his head outside.

We know that in four days the salt-marsh mosquito, *Aedes taeniorhynchus,* can travel as far as twenty-five miles and in all probability they may be able to travel twice as far.

Does is make sense to you to allow natural breeding conditions to continue year after year to produce mosquitoes in such astronomical numbers? It did not make sense to the State Board of Health and therefore they recommended to the Legislature that more consideration should be given to eliminating these gigantic breeding areas by filling and ditching so that high tides could flow and ebb through a system of minnow access ditches.

A ditching program inaugurated in two counties on the west coast of Florida two years ago already has made great strides in reducing the mosquito population. Some counties on the west coast of Florida will eliminate their heavy mosquito producing areas in the next two or three years and it is felt that most of the counties on the west coast of Florida in the next ten years will be able to reduce to a low percentage their heavy producing areas thereby making it possible to control the remaining small scattered breeding areas by larviciding.

The breeding potential on the east coast of Florida is much more difficult due to the large expansive marshes which will take many years to completely neutralize to the degree where breeding can be brought under control.

The control of salt-marsh mosquitoes in the southern tip of Florida presents a real problem with no economical solution in sight as far as permanent control is concerned. There is such a vast acreage in the ten thousand islands, the southern tip of Florida and the Florida Keys that it will be very difficult to construct minnow access ditches or to fill these difficult areas due to the hard digging in the limestone and coral formations.

Nothing has been mentioned about the sixty odd species of fresh water mosquitoes which are a menace to many sections of the State and the control of fresh water species by permanent methods present a tremendous and almost impossible task.

The creation of impoundments, the construction of dikes to hold back flood waters, while having their advantages from an agricultural point of view and from the standpoint of creating wildlife sanctuaries do present problems for the future as far as the transmission of mosquito-borne diseases are concerned. There is a grave possibility in southern Florida should water remain impounded for a number of years that in the gigantic sawgrass areas floating aquatic vegetation such as water lettuce, could produce on the roots of these aquatic plants conceivable billions of three species of *Mansonia* mosquitoes. Nature at the present time does a pretty good job of keeping the *Mansonia* mosquitoes fairly well under control in the Everglades section of Florida due to the long period of time *Mansonia* mosquitoes spend in the larval stage and the fact that the vast areas dry up every few years stopping breeding completely by the intermittent drying aad flooding of the area. To let the millions of acres become a vast lake and remain so for a number of years would certainly be conducive to the production of *Mansonia* in staggering numbers.

The expanded building program in this section has only one of three places in which to spread. One is into the Atlantic Ocean; second, to the south and southwest in the mangrove islands or third, to the west adjacent to the dikes.

Eastern encephalitis is prevalent in Florida and it is known to be transmitted by a *Mansonia* mosquito. The infection is not only found in man, but also in horse and bird. In Louisiana one of the white pond birds has been found to be around 45 percent infected.

These virus diseases are capable of explosive epidemics when factors become favorable for heavy production of the vector and a good reservoir of the virus is prevalent in an area. In California that very thing happened last year when there were around 650 human cases of Western encephalitis. In Cuba this summer it was reported that around 30,000 deaths in horses and some 40 deaths in humans occurred from Eastern encephalitis.

There is no question but what the same thing could occur in Florida unless we stay constantly on guard, because Florida's

tremendous growth, land reclamation and changing of natural flow of water adds to the difficulty of controlling mosquitoes. The mosquito control director not only has his trouble from natural causes but he must also battle the housing developer, and the farmer who wants to retain rain water on his field in the summer months to enable him to grow a truck crop in the fall.

Not only does the mosquito control director have his troubles from man-made hazards, but nature sometimes works against him in the form of high tides, heavy rainfall and in the past ten or twelve years there has been a marked increase in the mean sea level. It has been estimated by past information that the sea was rising at a rate of approximately one foot in 100 years. In the last 10 or 12 years the mean sea level has risen around one-third of a foot which can mean the difference between an area that did not breed salt-marsh mosquitoes ten years ago and one that is now productive.

It should be evident to all that in order to guide the State Agency having the constitutional and legal responsibility and the local agencies which have legal jurisdiction for protecting the health and comfort of the citizens of the State, that these agencies must be fortified with as much information as is possible to better enable them to carry out a safe, effective, and economical program in controlling arthropods of public health importance. To this end the State Board of Health is going to establish a research center on the southeast coast of Florida for the purpose of learning something about the intermost secrets of arthropods of public health importance in order that new and better ways and means may be found to control these animals.

It is expected that around $125,000.00 will be utilized in constructing and equipping the research center. In subsequent years it is planned to utilize around $150,000.00 a year for research and around $100,000.00 is to be used in administering the mosquito control laws and giving technical assistance to the counties by assisting them in planning and evaluating their temporary and permanent control procedures.

The purpose of the research center will be twofold: (1) to produce such biological information as the Bureau of Entomology needs in order to promote and carry out the most effective and efficient control possible, and (2) to expedite the incorporation of this information into control practices. In other words, this is to be a biological research center. It will

be intimately connected with the control operations in all districts so that its efforts will always be in the direction indicated by control needs. Under no circumstances will it undertake research of no value to the control of arthropods of public health importance or drift into a program of purely academic research. It is to be a center of biological research *within a control organization,* with none of the aloofness rightly expected, for instance, of a university laboratory with no control ties.

There is no question in my mind that with a better coordinated program between the coastal counties and with a research center to guide the State and the counties in their control activities that great strides will be made in the next ten years and that many sections along the coastal areas will be able to bring the salt-marsh mosquitoes under control.

STAUFFER AGRICULTURAL CHEMICALS

setting new standards of quality and service!

CAPTAN 50-W

PARAFLOW '400'

DDT — TOXAPHENE — CHLORDANE — HEPTACHLOR
LINDANE — BHC — PARATHION — ALDRIN
DIELDRIN — MALATHION

better disease control!	cleaner, smoother fruit!	better quality, higher yields!

"You Can ALWAYS Depend on STAUFFER Products!"

Stauffer CHEMICALS SINCE 1885

STAUFFER CHEMICAL COMPANY
APOPKA - TAMPA - WINTER HAVEN - VERO BEACH

CHLORDANE

CONTROLS THESE INSECTS

Ants	Mosquitoes
Armyworms	Onion Maggots
Blister Beetles	Onion Thrips
Boxelder Bugs	Plum Curculio
Brown Dog Ticks	Sarcoptic Mange
Cabbage Maggots	Seed-Corn Maggots
Cattle Lice	Serpentine Leaf Miners
Chiggers	Sheep Ked
Chinch Bugs	Silverfish
Cockroaches	Sod Webworms
Cotton Boll Weevils	Southern Corn Rootworms
Crickets	Strawberry Crown Borers
Cutworms	Strawberry Weevils
Earwigs	Sweet Clover Weevils
Fleas	Tarnished Plant Bugs
Flies	Termites
Grasshoppers	Ticks
Household Spiders	White Grubs
Japanese Beetle Larvae	Wireworms
Lawn Moths	
Lygus Bugs	
Mole Crickets	
Mormon Crickets	

AND MANY OTHERS

Write for Specific Technical Bulletins

VELSICOL CORPORATION

General Offices and Laboratories
330 East Grand Avenue, Chicago 11, Illinois

Export Division
100 East 42nd Street, New York 17, New York

REPRESENTATIVES IN PRINCIPAL CITIES

PETROLEUM DERIVED CHEMICALS
VELSICOL
SERVING BASIC INDUSTRIES

PESTICIDES

FOR

FLORIDA TRUCK CROPS

•

The Kilgore Seed Company, manufacturers and formulators of Insecticides and Fungicides, offers a complete advisory service to Florida Farmers through the facilities of its 14 Stores, Laboratory and technically trained Field Staff.

•

THE KILGORE SEED COMPANY

GENERAL OFFICES: PLANT CITY, FLORIDA
LABORATORY: WEST PALM BEACH, FLORIDA

•

Stores located at
BELLE GLADE, FT. MYERS, GAINESVILLE, HOMESTEAD, MIAMI, OCALA, PAHOKEE, PALMETTO, PLANT CITY, POMPANO, SANFORD, VERO BEACH, WAUCHULA, WEST PALM BEACH

For complete, accurate,

up-to-date information on

PARATHION

and

MALATHION

(also known as malathon)

direct your inquiries to the

developer of these important

broad-spectrum insecticides...

AMERICAN Cyanamid COMPANY

Manufacturer of Thiophos® Parathion Technical

and MALATHION Technical

AGRICULTURAL CHEMICALS DIVISION

30 Rockefeller Plaza, New York 20, N. Y.

Glance behind the agricultural research scene at Rohm & Haas and you would say: "The future is going to be rough on farm pests." And you would be right! Development of agricultural chemicals is hitting a faster pace than ever at the company's laboratories and experimental farms.

Hornworms and the red-banded leaf roller are kept under control by RHOTHANE; plant diseases are checked by DITHANE. Many pests on the farm must still be licked. But for every one, intensive research will ultimately spell control.

CHEMICALS FOR AGRICULTURE

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

DITHANE Fungicides

DDT Insecticides

LETHANE—fast knockdown agent in household and livestock sprays.

RHOTHANE (DDD or TDE) Insecticides

TRITON emulsifiers are offered in a wide selection for the emulsification of many organic pesticides used today.

WEED KILLERS

2,4-D and 2,4,5-T herbicides

2,4-D acid

Butyl and Isopropyl ester concentrates

Capryl ester low volatile formulations

Amine salt of 2,4-D

Ester formulations

Brush killer formulations containing capryl esters of 2,4-D and 2,4,5-T

DITHANE, LETHANE, RHOTHANE *and* TRITON *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

RIGHT NOW

Chinch bugs are a threat to lawns

dieldrin stops 'em

Dieldrin . . . famous throughout American farm areas for its deadly control of insect pests . . . is now available to home owners for lawn applications.

Dieldrin is particularly effective in controlling chinch bugs, ants, white grubs and other lawn insect pests responsible for bare spots, brown patches and generally poor lawn growth.

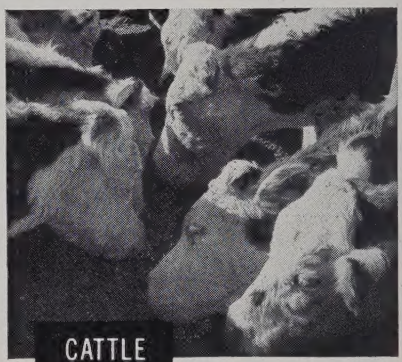
Dieldrin gets both the chinch bugs that feed on the grass above ground and the numerous kinds of pests that destroy grass roots beneath the ground level.

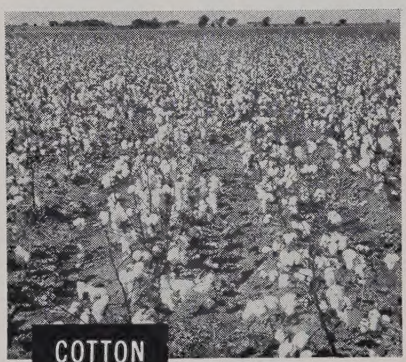
Dieldrin is now available at garden supply stores under various brand names. It is packaged in granular form and as an emulsible spray concentrate. In either form it requires only a thorough wetting down after application.

SHELL CHEMICAL CORPORATION
Agricultural Chemicals Division
710 Peachtree Street, NE, Atlanta 5, Georgia

TOXAPHENE PROTECTS

FOOD, FEED, AND FIBER CROPS





Wherever you live, it's probable that the crops grown there can benefit from insecticides based on toxaphene (chlorinated camphene 67-69% Cl). Recommended for effective control of more than 150 different species of insect pests, toxaphene dusts and sprays are helping to protect food, feed and fiber crops —to increase yields throughout the world.

Naval Stores Department
HERCULES POWDER COMPANY
INCORPORATED
949 King St., Wilmington 99, Del.

Your Profit Combination

For Crop Nutrition and Protection

FERTILIZERS
For every crop, for every need

PESTICIDES
Complete range of modern, scientific formulations.

GRO-TONE
Super Plant Food

For lawns, gardens and shrubs

EXPERTS at your service

Our qualified specialists are available for consultation when you encounter unusual problems in either your fertilizing program or pest control.

WILSON & TOOMER
FERTILIZER COMPANY
and Divisions
FLORIDA AGRICULTURAL SUPPLY COMPANY
Peninsular Fertilizer Works—Tampa • Cartledge Fertilizer Company—Cottondale
GENERAL OFFICES • JACKSONVILLE, FLORIDA

SPRAY or DUST

with Reliable, Dependable

Black Leaf 40 provides *multiple protection* against aphids, most thrips and similar sucking insects. Kills by contact and by fumes — versatile, economical, effective protection against crop losses.

Black Leaf 40 is *discriminating*. Controls aphids and other destructive pests — spares beneficial insects.

Black Leaf 40 is *compatible* with other standard spray and dust materials. Leaves no harmful residue.

Companion Products:

Black Leaf 3% Nicotine Dust
Black Leaf Nicotine-Rotenone-Sulphur Dust
Nico-Fume Pressure-Fumigators
Benzo-Fume Pressure-Fumigators
Nico-Fume Liquid

TOBACCO BY-PRODUCTS & CHEMICAL CORPORATION

RICHMOND, VIRGINIA